THE GLASS INDUSTRY

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GLASS DIVISION ACTIVITIES AT THE 54th ANNUAL A.C.S. MEETING

The 54th Annual Meeting of the American Ceramic Society was held at the Hotel William Penn, Pittsburgh, Pennsylvania. This was the first Annual Meeting in Pittsburgh since 1943. R. W. Douglas, of General Electric, Ltd., was present and was apparently the only representative of the many well-known English glass technologists. Mr. Douglas is Secretary of the Society of Glass Technology and a member of the International Commission. Professor S. R. Scholes informed the Section at its first session, Monday afternoon, April 28, that the lithoprinted reprints of the celebrated *Jena Glass and Its Scientific and Industrial Applications* by Hovestadt are now available at $4.00 a copy. Those desiring a copy of this book should write Professor Scholes, New York State College of Ceramics, Alfred, N. Y.

C. E. Leberknight, Kopp Glass, Inc., presided as Chairman except for sessions where F. V. Tooley, University of Illinois; F. L. Bishop, American Window Glass Co.; N. J. Kreidl, Bausch & Lomb Optical Co.; and K. B. McAlpine, Pittsburgh Plate Glass Co., presided.

A program of eighteen papers was provided by a committee under the chairmanship of K. B. McAlpine. The program consisted of a considerable number of theoretical and technical papers related to strength and structure of glass, as well as a number of practical papers involving melting operations and development of new products.

The first paper, "Interference Films on Glass: II, Some Phenomena Relative to Acid Etching of X-Ray Plate Glass," was presented by Scott Anderson and D. D. Kimpton, Anderson Physical Laboratory. The paper was read by the senior author. The glass used was an X-ray plate glass made by Pittsburgh Plate Glass Company. Its composition was 60% PbO, 8% BaO, and 30% SiO_2. The channelled spectra method [*J. Amer. Ceram. Soc., 34,* 141-145 (1951)] was not applicable to this type of glass, and other methods were therefore used. In order to measure the refractive index of the stain layers, a technique known as the "color reversal" method was used. The stain thickness was studied by means of a General Electric barium stearate step gauge. Determination of the index of refraction of the various stain layers together with a study of the various stain thicknesses with leaching time presented a means of interpreting the mechanism of the leaching process. It was believed that this process involved the procedure outlined below:

From the data and considerations presented above, the investigator may infer the following regarding the leaching process of X-ray plate glass in HCl. The initial attack was a direct chemical reaction between the acid and the lead in modifier positions, probably a conversion to lead chloride and water. This conversion gave rise to a porous film with a greatly reduced refractive index. This process soon reached a limit set by the difficulty of the acid's reaching the modifier ions. Further increase in the stain thickness must, therefore, rely upon the diffusion of lead ions outward through the film. (Of course, this process began immediately, but it was not then the predominate factor at the temperatures reported here.) However, the disruption of the film continuity rendered diffusion more and more difficult because the leaching process itself reduced the available sites for outward progression of the lead ions. Consequently it was not proper to speak of a "diffusion constant." This resulted in the film growth's being a function of time to some power of the order of one-third. Thus, on this basis it was expected that the stain growth curve would be rather well resolved into two distinct parts: a linear section followed by a $t^{1/3}$ section. Moreover, the above mechanism was in agreement with all the other known facts including the variation of the refractive index, its porosity, softness, and infrared spectra.

The second paper, by I. Simon and H. O. McMahon, Arthur D. Little, Inc., treated the subject "Study of Some Binary Silicate Glasses by Means of Reflection in Infrared" and was presented by the senior author. A study of the structure of glasses by means of their infrared spectra was undertaken. A study of the reflection spectra in the infrared region of various modifications of silicon dioxide such as quartz, cristobalite, and vitreous silica made it possible to assign the strongest infrared band observed at approximately 9μ (or approximately 1100 $cm.^{-1}$) as a bond-stretching vibration of the oxygen shared by two silicons. These observations were further supported by similar data collected on several organo-silicon compounds containing Si-O-Si groups.

Newly elected officers of the A.C.S. Left to right: Vice Presidents, H. B. DuBois, Consolidated Feldspar Corp.; H. H. Holscher, Owens-Illinois Glass Company; Victor C. Swicker, Alexander H. Kerr & Company. Treasurer, Edwin M. Rupp, Flamingo Tile Corp. President-Elect, R. R. Danielson, Metal & Thermit Corp. President, W. Edward Cramer, Industrial Ceramic Products, Inc.

When the crystalline modifications of silica were converted into the vitreous form, all bands corresponding to cooperative vibrations of a periodic lattice with a well-developed, long-range order disappeared while the 1100 $cm.^{-1}$ band persisted because it was caused by a vibration of immediately neighboring Si-O-Si groups. Measurements were also made on a series of soda-silica glasses in an interval of 0 to 46 mole per cent. Binary glasses containing Li, K, Ca, Sr and Ba oxides were also investigated. In addition, four natural silicates: olivene, willemite, zircon and wollastonite were studied. The infrared measurements indicated that the short-range order in silica remained unaffected by the transition to the vitreous state and that the force constants approximated those of cristobalite. When alkali or alkaline earth modifiers were introduced into the silica network with gradually increasing percentages, significant changes in the infrared spectra were observed. When the amount of added cations was large, the characteristic feature of the silica lattice network, namely, the sharing of oxygens, was destroyed and new bands appeared in the spectra.

Another paper of fundamental interest entitled "Glass with Conducting Surface Layer for Grading High Potentials" was presented by K. B. Blodgett, General Electric Research Laboratory. Dr. Blodgett reviewed the experimental technique and results of her paper: "Surface Conductivity of Lead Silicate Glass after Hydrogen Treatment," *J. Amer. Ceram. Soc.*, 34 (No. 1) 14-27 (1951). A high-lead X-ray glass having the following composition: PbO, 61%; BaO, 8%; and SiO_2, 31% was treated with hot hydrogen for the purpose of developing conductivity in a thin layer at the surface. The specific resistance was 800 ohm-cf. or more, depending upon the hydrogen treatment. The resistance was stable at potential gradients up to 50 kv/in. and had a small negative temperature coefficient. The time and temperature of hydrogen treatment were highly important. The ratio of hot-to-cold resistance was constant for various values of cold resistance. The conducting layer was found to be from 50 to 100 a.u. thick, and the conducting substance was a semiconductor in which monoatomic lead atoms were dispersed in glass. The reduced lead atoms probably served as the centers which supplied the electrons, whose density was found to be one millionth of the total density of lead atoms in the glass. The remainder of the lead gathered into aggregates which gave the glass a black color, but made no contribution to the conductivity. The amount of conductivity which can be developed was thus shown to depend upon a number of factors, and treatment at temperatures ranging from 335 to 400°C. gave the better results.

The next paper, "Glasses for Transmitting Near-Infrared Radiation," F. D. Lorey and H. H. Blau, Ohio State University, was presented by F. D. Lorey. Glasses needed for high infrared transmission were developed from a study of $PbO\text{-}Al_2O_3\text{-}GeO_2$ and $PzO\text{-}La_2O_3\text{-}GeO_2$ systems. In general, the glasses were high in PbO, 40-60%, and the larger ionic radii of the glass former produced a greater cut-off in the longer wavelengths. Although lanthalum and alumina showed a definite decrease in the tendency to devitrify, they had little effect on weathering. Generally, high-lead glasses gave good resistance to weathering. However, the silica glasses had higher resistance than the germania glasses.

Transmission was definitely affected by melting in a moisture-free atmosphere, such as oxygen or nitrogen. A similar effect also resulted from the use of a dehydrating technique at 400°C. after melting.

Near-infrared transmission may be extended to longer wavelengths by introducing larger and heavier network-forming ions and by eliminating the smaller and lighter network-forming ions from the system. The obscuring absorption in the 2.7-4.5 micron region for lead oxide-silica and lead oxide-germania glasses was caused by water vapor and hydroxyl groups. This phenomena may be minimized through melting or remelting the glasses in moisture-free atmosphere. Lead oxide-germania glasses of practical weathering resistance were obtained by using more than 40% lead oxide content. Still further improvement was made by using higher lead oxide content and the introduction of stabilized oxides.

A number of papers were devoted to a study of various factors involved in the measurement of the strength of glass.

The first paper in this series, "The Strength of Glass," by D. A. Stuart, Cornell University, and O. L. Anderson, University of Utah, was presented by D. A. Stuart. It was a highly theoretical one in which glass was visualized as being composed of a large number of Hookian springs possessing perfect elasticity. The mathematical treatment related the strength of glass under constant load to (1) the duration of the test, (2) the temperature and effects of the ambient atmosphere, (3) the presence or absence of any surface defects, and (4) the residual stresses which may be present in the material. The equation developed attempted to show that any stress equal to or less than a particular stress, called the static fatigue limit, will not cause fracture to occur in any finite time. The dependency of the fatigue limit upon all of the above factors was demonstrated. It was also shown that the "stress-time curves" for all glasses would be reducible to a single narrow band, if the data were plotted in a particular form. The data of Baker and others were used to evaluate the various parameters which appear in the resultant equation.

Dr. F. W. Preston complimented the authors on attempts to apply the rate-process theory to the strength

F. V. Tooley

of glass and also on their efforts to determine the various variables. "The ultimate strengths of glass can be varied from 10,000 to 500,000 lbs. per sq. in., depending upon how it is measured and what variables are assumed. If we try to eliminate the surface flaws to a minimum, perhaps the best fundamental picture will result," Dr. Preston said.

Additional experiments were suggested, and a need for research to verify or modify the theory was emphasized.

The second paper in this group, "Time Effects in Fracture of Glass," was presented by Edward Saibel, Carnegie Institute of Technology. Mr. Saibel attempted to explain from a thermodynamic standpoint and by the use of hypothetical models a unified theory of fracture of glass. The following time effects were considered: (1) static fatigue or the delayed fracture of glass under a constant load, (2) influence of strain rate on fracture stress, and (3) speed of propogation of fracture. The influence of temperature and stress system on all three processes was found, and the importance of separating effects (1) and (2) was emphasized. The breaking of glass was visualized as the breaking of bonds of atoms in a critical area that could be influenced by surface chemical attack or a change in statistical environment. "There is an energy level for the hypothetical model below which fracture will not take place. Once the energy barrier is exceeded, however, fracture may proceed." Mathematical formulation demonstrated that the velocity of propogation of fracture approached that of sound. This fact has been confirmed by Edgerton and others. "The method used was an application of the statistics of chemical reaction-rate theory to the breaking of bonds, taking into account the changing of the system as the breaking of bonds proceeds." There was apparently room for re-arrangement of structure in approaching failure, and the endurance limit may be theoretically determined and of value in determining fracture. The importance of obtaining actual research data was again emphasized, and it is hoped that these papers will stimulate work in this field.

The next paper, "Influence of Certain Surface Treatments on Strength of Glass," V. K. Moorthy and F. V. Tooley, University of Illinois, was presented by F. V. Tooley.

Previous work concerned with the effect of water on the tensile strength of constricted rod specimens, 0.011 in. in diameter, showed the following results: (1) decreases in strength when freshly prepared samples were broken under water; (2) increases in strength when specimens were soaked in water before breaking.

Further experiments were made in which constricted rod samples of soda-lime-silica glass were broken under a wide variety of organic liquids that consisted of various alcohols and hydrocarbons whose structures varied systematically. The alcohols contributed definite increases in strength, while the hydrocarbons showed little effect on the strength. Interpretation of the data indicated that the more complex molecule and increased chain lengths of the alcohols made it increasingly difficult to penetrate the surface of the glass. Attempts were also made to relate the results on the basis of the polar characteristics of the organic molecules. The question was also raised whether or not the organic liquids did not exert some effect on the water present on the surface of the glass. "Additional experimental work involving the superimposing of soaking treatments in water and organic liquids, followed by breakage in air, under water or an organic liquid, gave some evidence of additive behavior with respect to strength." The less complex the liquid, the better the correlation with strengths obtained in air alone.

The next paper, "Influence of Water Soaking Temperature on Tensile Strength of Soda-Lime, Lead, and Hard Borosilicate Glasses," V. K. Moorthy, F. V. Tooley, and G. F. Stockdale, University of Illinois, was also presented by Dr. Tooley. Considerable increase in tensile strength

New Fellows announced by the Society. Left to right: W. F. Rochow, Harbison-Walker Refractories Company; Franz G. Schwalbe, Toledo Engineering Company; James L. Crawford, Walsh Refractories Corp.; Herbert F. Royal, Champion Spark Plug Company; Alice J. Gitter, Whittaker, Clark & Daniels, Inc.; John J. Hazel, Republic Steel Corp.; Ray W. Pafford, Acme Brick Company; H. K. Richardson, Bloomfield, N. J.; Dana Chase, Dana Chase Publications; and William E. Dougherty, The O. Hommel Company.

of glass was obtained by soaking the specimens in water at 90° C. The increases in strength were also shown to depend upon the time of soaking. After treatment with water, lead glasses showed the least increase in strength, soda-lime glasses a greater increase in strength, and hard borosilicate glasses the greatest increase in strength. There appeared to be a healing action of the water owing to surface chemical attack when the rod specimens were soaked in water, producing a reduction in stress-concentration potentials of flaws. Increase in temperature of the water apparently tended to hasten or intensify this beneficial reaction with the resultant increase in strength. A constant soaking period of 24 hours and soaking temperatures of 30° and 60° C. were maintained.

A paper from the National Bureau of Standards, "Glass-Forming Region in the BaO-B_2O_3-SiO_2 System," E. H. Hamilton, O. H. Grauer and G. W. Cleek, was presented by the senior author. This paper was another example of the value rendered to industry by the Bureau. The region of glass formation was established in the system BaO-B_2O_3-SiO_2. All glasses were melted in platinum crucibles, thoroughly annealed and analyzed. The liquidus temperatures were determined by a gradient method and the primary phases were identified. The indices of refraction and density of all glasses were determined. The index (N_D) varied from 1.5472-1.6712, and the density from 2.642-4.29. The area of immiscible liquids was shown to extend well into the three-component system at the high B_2O_3 end of the triaxial. Nine compounds were identified, and the anomalous behavior of the mixtures indicated that it was caused by compound formation. When SiO_2 was substituted for B_2O_3 as BaO was held constant, the index of refraction increased at first, reached a maximum and then decreased. Fundamental data in this field of glasses may prove highly important to industry.

Another paper of a highly theoretical nature, "Dependence of Ionic Conductivity in Glasses upon Chemical Composition," by O. L. Anderson, University of Utah and D. A. Stuart, Cornell University, was read by Mr. Anderson. Electrical ionic conductivity of glasses is known to be strongly dependent upon temperature, structure and chemical composition. Previous work had indicated that this conductivity was largely due to the sodium ion, but other ions were also known to contribute to some extent to the conduction process. Anderson believes that it is difficult for ions to migrate through the hole position if they are smaller than Na^+ because of the strong chemical bonds that must previously be broken. It is also difficult for ions to migrate through the hole position if they are larger than Na^+ because a distortion of the holes must first take place. The Na^+ ion is therefore the ideal size for ionic electrical conductivity. "A method is proposed to establish the degree to which a glass is either a conductor or a resistor in terms of composition. The temperature dependence of the conduction process is known to be an exponential function involving a free energy of activation. The effect of composition is shown to be found in this free energy of activation, such free energy of activation being identified with the ionic parameters, valance, ionic radius and coordination number. It is shown, as a consequence of the theory, that if the temperature at which two different glasses have the same resistivity be measured, the ratio of these temperatures is the ratio of the free energies of activation, as was found experimentally by Gehlhoff and Thomas. The manner in which composition affects conduction through the mechanism of changing the structure is investigated." This paper was very well presented, and was an attempt to present theoretical explanation of an important property of glass.

Howard Lillie, retiring president, addressing the banquet audience.

The next paper dealt with the interesting problem of glass-to-metal seals. "Wettability of Some Group I and VIII Metals by Several Sodium Silicate Glasses," V. F. Zackay, D. W. Mitchell, S. P. Mitoff, J. A. Pask, University of California, was presented by V. F. Zackay. The success of sealing glass and metals was shown to be greatly dependent upon the wettability and spreading of glass over the metal surface. The degree of wetting was determined by measurement of the contact angle of a glass with metal. The measurements were observed in vacuum, helium, hydrogen, oxygen and air atmospheres. Three sodium silicate glasses having 30.8, 33.6 and 33.9% Na_2O were used. The metals used were Cu, Ag, Au, Pd, Pt and Ni. All metals were obtained from the Bureau of Standards and were thoroughly cleaned, degreased, treated with acid, polished, and heated in vacuum to remove adhering surface gases. The results indicated that wettability as measured by contact angles was independent of glass composition or grain size of the metal. Certain theories were given for these results and were believed to depend upon the development of films on the surface of the metals, solubility of certain gases (from the metals) in the glass, as well as the polarizing power of the metals.

A paper of more practical interest, "Special Glasses for Manufacture of X-ray and High Voltage Rectifier Tubes," by M. J. Zunik and J. B. Gosling, General Electric Co., was given by Mr. Gosling. Not only has X-ray tube manufacture changed greatly in the past few years, but also changes in design and physical requirements have made increased demands on this type of product. Parallel developments have also been made in glass sealing to metals; for example, hard borosilicate glasses have replaced the softer soda-lime glasses. The requirements of these borosilicate glasses have been increased by higher voltages and higher current ratings. Numerous seals and high resistivity have resulted in puncturing of the glass tubes, thus showing a need for newer glasses. The glasses now used are known as L-650, 705AJ, Nonex 772, Pyrex 774. Sealing to metals, such as Covar, is highly important. The sealed glasses invariably change from a straw to brown color owing to X-ray exposure. No way is

known to prevent this discoloration, nor are there any adequate theories to explain it. Production methods were illustrated, and the general requirements for an all-purpose glass given.

"Some Factors in Glass Tank Operation and Design," F. L. Bishop, Jr., American Window Glass Co., was the next paper presented. In outlining the results of numerous practical experiments made on glass tank operation, the author pointed out that the physical properties of glass itself affected its behavior in a tank. The physical characteristics of the tank—especially its size, shape, and temperature distribution—determined the flow of glass. The liquidus temperature of the glass was shown to be highly important in regulating its flow, and temperatures must at least be kept above this temperature. The size of the melting end of the tank is dependent largely upon the capacity of the operating machines. The depth of the tank was determined largely by the temperature gradient needed to stimulate vertical currents. The depth of the refining end of the tank was determined primarily by the depth needed to maintain at least the liquidus temperature of the glass. The tank can be streamlined sufficiently to move glass to the forming machines as rapidly as quality will permit.

A technique was described to measure the "point velocity" in a tank at various positions. These measurements were shown to have a direct correlation to the successful operation of the tank. Such data were also demonstrated to have value in indicating change in design for better tank performance. It is hoped that industry will make further use of this technique of "point velocity" to improve melting operations and manufacture.

Another interesting paper was "Phases Concerned in the Corrosion of Tank Refractories by Glass," C. A. Lambelet and R. B. Sosman, Rutgers University. It was presented by R. B. Sosman. Practical and also fundamental, the paper indicated the possible phases formed at the interface of refractory and glass. The primary phase is the one that does not dissolve under the particular conditions of temperature, etc. at the interface. Because the contact of refractory and glass is atomic, Sosman believes that a migration or penetration of Na_2O or alkalies toward the refractory and a counter-movement of Al_2O_3 toward the glass takes place. Experiments were made involving mixtures of the pure oxides Al_2O_3, CaO, Na_2O and SiO_2, corresponding to mixtures of a standard glass with a fusion-cast refractory. The results showed that the stable phases, in order of appearance from 100% glass to 100% refractory, were devitrite, wollastonite, albite-anorthite crystalline solutions and corundum. Contrary to expectation, mullite did not appear at all. It was presumed that Na_2O diffuses more rapidly than the other phases, thus accounting for the predominance of soda minerals and the lack of mullite. The relation of the composition-temperature curves upon the corrosion phenomena was discussed.

The next paper, "Surface Tension of Molten Alkali Borates," Leo Shartsis and Webster Capps, National Bureau of Standards, was presented by Webster Capps. As a part of a study of the fundamental physical properties obtained with simple glasses, surface tension measurements were made. The determinations were made by measuring the maximum pull on a Pt cylinder. When the alkali metals were added to B_2O_3, the surface tension was raised. In the high-alkali range, the order $Li^+ > Na^+ > K^+$ was observed for surface tension and for the algebraic value of the temperature coefficient of surface tension. In the low-alkali range (up to 15 mol %) the order of surface tension was $K^+ > Na^+ > Li^+$, while the temperature coefficient of surface tension, independent of the type of concentration of alkali ion, had approximately the same value as that of B_2O_3. This characteristic was believed to be due to the definite tendency of borates to form immiscible liquids. Pb and Zn had unusual effects in that the first additions of these ions to boron had little effect on the surface tension, and the effects were not pronounced until higher concentrations were made.

The next paper was "A Note on the Thermal Expansion of Mica," J. L. Gallup, Radio Corp. of America. The author emphasized the practicality of knowing the proper expansion of mica. The increased use of glass-to-mica seals has indicated a need for exact information on the thermal expansion of mica, especially when used as windows in high-frequency power tubes. The expansion determinations were made in a quartz expansion furnace, and samples of mica carefully prepared and reinforced with a wire loop were found to give the most consistent results. The reinforcements were designed so as not to interfere with the expansion measurements. Determinations were made by both heating and cooling techniques and were found to check accurately. Two samples of clear muscovite mica from different sources showed a difference of the order of 6%, depending upon the crystallographic direction of measurement. The expansion range covered by the maximum and minimum expansion varied with the geographic source of the mica —even though both samples were muscovite. In order to use intelligently mica for seals, it was recommended that each shipment be checked for expansion.

The paper "On the Thermal Shock Resistance of Sheet Glass," W. C. Levengood and E. C. Montgomery, Libbey-Owens-Ford Glass Co., was presented by W. C. Levengood. Although the thermal shock resistance of sheet glass has received considerable attention, the published data have been limited. An excellent review of the work of Dinger, Hampton, Winkelman, Schott, Watkins, Wampler and Sharp was given. Products of the temperature difference and the square root of the thickness ($\Delta t \sqrt{d}$) for the Dinger data and those of Watkins and Wampler were found to be in substantial agreement.

A test was described in which 4" x 4" samples were plunged into ice water after being heated to a prescribed temperature. Tests were started with the glass at a temperature low enough for no breakage to occur and were continued at 1° C. temperature intervals until all samples fractured. Temperature differences were noted and curves plotted. It was demonstrated experimentally that edge-seaming the glass produced slightly higher thermal shock values. On the other hand, allowing the glass to age after cutting or seaming produced a marked increase in the thermal shock resistance of the glass. The effect of the coefficient of expansion on the thermal shock was considered, and an expression was evolved for determining the thermal shock resistance for glasses in the range of expansions from 32×10^{-7} to 92×10^{-7} per ° C. It is hoped that more work will be published on this practical and important property of glass.

The final paper, "The Use of Strain Gauges for Deter-

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SHIELDING FOR RADIANT HEAT IN A GLASS PLANT

By KARL L. DUNN, INDUSTRIAL HYGIENIST
Corning Glass Works, Corning, N. Y.

Until comparatively recently the high temperature industries have depended almost entirely upon convective or induced convective cooling to promote comfort in the work areas. Although direct radiation from hot surfaces was recognized as a major source of discomfort in the glass plants, only very sketchy work was attempted to reduce the intensity of this radiation.

About fifteen years ago it was called to our attention that over 50 per cent of the heat loss from surrounding tank furnaces was in the infrared spectrum. Following this, considerably more attention was given to radiant heat than had previously been given to it, but it was only after the organized study of several large glass industries, under the direction of the Industrial Hygiene Foundation, in a quantitative determination of heat sources that any real logical engineering work was attempted.

In review: the first thing to be done was to familiarize ourselves with the basic laws of radiant heat. This is probably best explained by the Stefan-Boltzman equation. This equation says simply that the total radiant flux is proportional to the fourth power of the absolute temperature of the radiating source. We have assigned a value of 1.0 to the emissivity, or the ability of the body to radiate. The Stefan-Bolzman constant is merely a factor to reduce the final radiant flux values to gram calories per square centimeter per second.

Assuming we have a furnace operating at 1,000° absolute, we find that we have a total radiant flux of gram calories per square centimeter per second of 1.35. If we increase the absolute temperature of this radiating object to 1,100°, the temperature increase has been increased by 10 per cent. The interesting fact, however, applying the Stefan-Bolzman Law, is that the radiant flux has increased 44 per cent.

To further illustrate the extreme importance of radiant heat in high temperature industry, we again increase the temperature to 2,000° absolute where we find a temperature increase of 100 per cent and striking increase of radiant flux of 1,500 per cent. These simple calculations impressed us and others with the importance that radiant heat plays in discomfort to workers of the high temperature industries.

After this review of the principles of radiant heat, we were then faced with the fact that the problem of heat in our plants and work spaces, if it were largely radiant heat, was one not primarily of convection or thermodynamics but rather one of optics, recognizing that infrared obeys all the optical laws common to visible light. Interposition of opaque objects between the radiating source and the man seemed at first the simplest solution to the radiant heat problem.

This is true for short term exposures in which the opaque object does not rise in temperature to that of the surroundings. If the opaque shield is of high emissivity or conversely of high absorptivity, the opaque screen will eventually arrive at a temperature where it begins to reradiate itself, and if the shield or screen is closer to the man than the original radiating object, it merely serves to intensify the problem. It seems, then, that the correct approach to this problem of materials for opaque shields was to select an economic material which had an emissivity low for the infrared and high in reflectivity.

Most metals have a high reflectivity to the wavelength 2.0 microns which was selected as being about median in the temperature range that we were experiencing in the high temperature locations. Materials such as gold, silver and platinum were immediately abandoned because of the cost angle. Aluminum seemed, after an exhaustive search of materials, to be the ideal material for one to use for several reasons, the major one being the fact that aluminum oxidizes very slowly and the thin oxide coat retains most of the initial reflectivity.

Aluminum paint is only about 50 per cent reflective and was abandoned early in this study as a material suitable for reflective shields. Asbestos paper is extremely low, having its value primarily as an insulating material in convective heat problems. White paint, or white lacquer, again has an extremely low reflectivity to the infrared, and conversely these three materials would have a high absorptivity to the infrared and, in a short time, after being exposed to high radiant sources would tend to reradiate.

After considering this problem theoretically, we then decided to review the entire heat problem as far as the glass trade was concerned. We will attempt to illustrate the various steps through which we have passed in the glass trade in coping with the heat problem. First is the typical glass plant. A centrally located furnace supported upon pylons at the second floor level has as its only means of losing heat direct radiation and air flow or convective flow through an annular space which extends around the periphery of the furnace. The roof is constructed in a simple monitor form, allowing the heat and generated gases to escape by gravity from the open windows. For a great many years this was the only system used and the only one we could depend upon for cooling air within the plant walls themselves.

The next stage was that in which portable fans were used to circulate the air to keep the air in motion around and about the work spaces. Here we found the beginnings of opaque shielding. Materials such as wood, asbestos board, black iron, etc., were used. A great disadvantage of the portable fan was the fact that they tended to circulate air over the hot surfaces and multiply the problem in hot weather by recirculating and moving the super-heated air over the workmen.

The furnace continued to radiate to the steel structural and building walls. No provision was made for air supply from the basement or within the work space. The monitor remained in its conventional form dependent entirely upon gravity for removal of heat and gases from the furnace itself. This represents the condition that existed until a few short years ago in most of our plants.

With the application of the present knowledge of radi-

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Presented before the Glass and Ceramics Section, National Safety Congress.

GLASS CONTAINER MANUFACTURERS REVIEW POSITION IN A DEFENSE ECONOMY

On Monday, May 19, Joseph C. Feagley, Vice President and General Manager of the Glass Container and Closure Division of Armstrong Cork Company and President of the Glass Container Manufacturers Institute, called to order the Semi-Annual Meeting of the Institute in The Greenbrier at White Sulphur Springs, West Virginia.

With this meeting, Mr. Feagley completed his term of one year as President of the Institute. Howard C. Herger, President of Pierce Glass Company and for the past year 1st Vice President of the Institute, succeeds Mr. Feagley to the presidency.

J. M. Foster, President of Foster-Forbes Glass Company, was elected 1st Vice President, and Bert Cremers, Vice President of Wyandotte Chemicals Corporation, becomes 2nd Vice President of the Institute.

Re-elected to the Board of Trustees for a term of three years were Royden A. Blunt, President of Buck Glass Company, and Howard C. Herger. Newly elected to the Board is Franklin B. Pollock, President of Thatcher Glass Manufacturing Company.

It was announced that Hazel-Atlas Glass Company, who has contributed to the Institute and whose technically skilled employees have cooperated with G.C.M.I.'s nine standing committees, has become a regular member.

J. M. Foster

Bert Cremers

Milton M. Olander, of the Owens-Illinois Glass Company, delivered an interesting address based on his experiences as an industry member of the Wage Stabilization Board.

John C. Clay, Director of the Containers and Packaging Division, National Production Authority, and whose civil job is assistant to the executive vice president of National Starch Products, Inc., discussed the newly amended schedule 2 to M-80 covering cobalt. The amendment permits the continued use of cobalt for decolorizing but specifically forbids its use as a colorant for any glass or ceramic products. Mr. Clay asked interested glass manufacturers to give the Containers Division of NPA details of their use and requirements of cobalt as a basis for working out some arrangement whereby affected manufacturers would be allowed to continue at least limited use of this critical material.

Horace B. McCoy, Assistant Administrator, NPA, and well-known to the glass container industry, in his most interesting talk "The Civilian Economy With A Long Term Defense Program" opened his address by saying, "The nature of my subject today is not specifically directed at glass containers and allied lines. In view of my interest and responsibility in NPA for a large segment of consumer industries in the defense program, and my permanent interest in these industries in connection with my work in the Department of Commerce, Mr. Hall suggested that I participate in this meeting and discuss with you some of the more important aspects of the economic problems of the future in carrying on a large defense program, in addition to and along with our normal civilian economy. I am very happy to do this, but at the outset I wish to make it clear that I intend in no way to make forecasts or predictions. I will endeavor to present my ideas about some of the important factors which will influence our future economic affairs."

As a backdrop for his main topic, Mr. McCoy further stated, "Before speaking directly on my general subject, I want to make a few observations with regard to the status of our current defense program. I want to do this lest some or all of you might assume that the very fact that I am addressing my remarks here to factors which will influence our future economic affairs is an indication that I and my colleagues in the NPA believe that the objectives of our defense program have been achieved and that we can now turn our thoughts and efforts to other matters. The trade press and the daily newspapers now carry almost as many news stories on decontrol and demobilization as they did on controls and the progress of the mobilization effort barely six months ago. Mr. Fowler, NPA Administrator, announced decontrol measures last Friday which made the headlines of most newspapers and the trade press. While these developments are important to many businessmen, it should not be assumed that the lifting of some controls, if and when necessary and desirable, means that we have completed the defense production job and can fold up our organization and turn to other matters."

Referring to the future of defense agencies, Mr. McCoy said demobilization was expected in 1953. It is expected, according to Mr. McCoy, that the Department of Commerce will be required to carry on whatever controls are left in being at the time of demobilization. The thought was expressed that the Commerce department should be the focal point in government-industry relations. To this end Mr. McCoy does not want to scrap the present organization as set up by industry division with the NPA.

There will, of course, be a reduction in the present force when demobilization comes. However, Mr. McCoy feels that the data collected during NPA should be kept alive by standby staffs and that these staffs should also plan for future mobilization. Speaking specifically of the Containers and Packaging Division, he said a nucleus group should be kept in being in the Department of Commerce ready to go "at the blast of a whistle."

Mr. McCoy urged that industry advisory committees, similar to those now cooperating with NPA should study the form this proposed organization should take and keep in touch with the standby group through the demobilization period. The period of defense controls, Mr. McCoy said, may be 5-10-20 years, or a lifetime, and the Commerce department wants advice from industry.

"General Business Outlook for 1952 with Special Reference to the Glass Container Industry" was the title of a talk by C. C. Merrifield of the Econometric Institute. Mr. Merrifield's discussion highlighted many salient factors in the broad economic picture.

Victor L. Hall, General Manager of the Institute, in his report to the membership, stated that four new furnaces have been added to the industry's capacity during 1951 amounting to an increase of 3.6 per cent. The industry's 1952 capacity is 146 million gross. In 1951 shipments of glass containers stood at 83 per cent of capacity and in the first quarter of 1952 production was running about 73-74 per cent of capacity with not much improvement expected this year.

Current improved shipment figures for specific types of glass containers from a standpoint of size and types of products packed were presented and Mr. Hall wound up his talk by saying that "considering normal seasonal trends, the first quarter shipments indicated an annual rate of around 108 million gross."

Harry W. Kuni gave his usual succinct and business-like report as Secretary-Treasurer of the G.C.M.I. and Fred E. Fuller, the Institute's General Counsel, spoke on the progress the Institute had made since its inception.

"Glass Containers and Competitive Packages" was the subject of a talk by Felix F. Eberhart, Editor of THE GLASS PACKER, sister publication to THE GLASS INDUSTRY. Mr. Eberhart illustrated the trends in various packaging materials and urged the glassmen to aggressively combat the attacks on the glass container by manufacturers of other packaging materials. A focal point in Mr. Eberhart's talk was the outstanding merchandising virtue of the glass container—visibility.

An inspirational message which enthralled the entire membership and those ladies who were present was the "sermon" entitled, "Outlook for America" by Dr. William H. Alexander, pastor of the First Christian Church of Oklahoma City, Oklahoma, and presently Chaplain of the Republican National Committee.

On the social side of the meeting, a most enjoyable cocktail party was given by Thatcher Glass Manufacturing Company, with Mr. and Mrs. Franklin B. Pollock as hosts. The G.C.M.I. banquet was, as usual enjoyed by all. Despite dubious weather, golfers were out in full force to compete for a diversified group of excellent prizes. The ladies bridge also brought forth a large number of contestants for a number of attractive prizes.

It was announced that the Annual Fall Meeting will be held in The Homestead, Hot Springs, Virginia, the week following the national elections—November 10, 11 and 12.

Brief outlines of the activities of the Institute's Nine Standing Committees follow:

Market Research

In his report for the Committee on Market Research and Promotion, Chairman Francis H. May stated that circumstances which brought to a conclusion the industry marketing program and on which he reported a year ago in some detail had not changed and, as a result, the Committee remains inactive.

Traffic

A. F. Huni, formerly General Freight Agent with the New Haven Railroad and who recently joined the Institute as Director of Traffic, ably and interestingly highlighted the written report of the Traffic Committee prepared by its Chairman, E. G. Seidle of Armstrong Cork Company.

R. A. Blunt

F. B. Pollock

A downward revision in carload rates for glass containers from Northern (Official) Territory to North Atlantic ports for export, coastwise and inter-coastal movements is hoped for after certain related freight rate details have been adjusted.

The Traffic Committee further reported on several other matters such as the permanent establishment of reduced carload rates on soda ash between points in Northern Territory, efforts to obtain the restoration of basic differentials in freight rates in Northern Territory on sand as they apply to shipments in closed cars versus like shipments in open cars. The rate relationship which is sought to be restored prevailed prior to July 1, 1946. Since that date, the general increase in freight rates has completely disrupted this relationship.

In concluding his written report, Mr. Seidle stated: "The present and future are fraught with a multitude of complex problems engendered by a seemingly endless inflationary spiral. As a result, accurate advance determination of costs, especially those for transportation, for any reasonable period is almost impossible. The need for an equitable relationship—cost versus price—was never more important."

Government-Industry Relations

S. B. DeMerell, Vice President of Anchor Hocking Glass Corporation and Chairman on Government-Industry Relations, briefly reviewed his written report to the Board of Trustees.

In connection with the Committee's work with the Office of Price Stabilization, Mr. DeMerell stated: "It gives me great satisfaction to be able to report that OPS acted favorably on the request made by the industry for an increase in ceiling prices on glass containers. At the time of my last report to you in October 1951, the Econometric Institute had just commenced its survey for the purpose of compiling industry data for use by the Industry Advisory Committee appointed by the government to assist OPS on industry price matters. While the composite data developed from the survey was presented to officials of the price agency on December 20, 1951, it was not until March 20, 1952 that the Glass Container Industry Advisory Committee was called to Washington for a further discussion of the price relief requested.

"On April 23, OPS released supplementary Regulation 99 to the General Ceiling Price Regulation authorizing four per cent increase in the ceiling prices on glass con-

tainers, such increase to be effective April 28, 1952.

"With respect to possible future industry requests for price relief, it would appear from contacts by our industry representatives with OPS and from published statements by that agency that the basis of justification of any increase may be the so-called Johnson Industry Earnings Standard. This comment, of course, is predicated on Congress extending the Amended Defense Production Act substantially in its present form. The Act as now written is due to expire June 30 of this year.

Mr. DeMerell, commenting on orders of the National Production Authority, stated that it was felt that the problems of the glass container and closure manufacturers with respect to this agency were becoming fewer. In this connection, he pointed out the revocation of the glass container Order M-51 and substantial relaxation of the closure Order M-26.

It was reported by Mr. DeMerell that the work on the Battelle Gas Producer Project will continue until December 31, 1952 as authorized by the G.C.M.I. Trustees in a meeting in March of this year. It is expected that the research team in charge of this project expects to be able to reach fairly definite conclusions in the very near future.

Mr. DeMerell reported briefly on the contemplated increase in duties by Venezuela on imported glass products. United States exports of glass containers to this country being of a fairly substantial volume, steps are being taken to safeguard American interests through the U. S. Department of Commerce and the Committee for Reciprocity Information. The closure industry is also being represented in the discussions.

Late last year the U. S. Customs Court rendered a decision in the most recent of a series of cases which extend over a period of some years having to do with the proper classification of bottles imported into the United States that were not produced on automatic machines. This latest case involved Yardley & Co., Ltd. and the decision of the court was in favor of the U. S. Government. Importers have insistently sought to establish that glass containers made by manually activated machines of the so-called Schiller type should be permitted to enter at the low rate of duty applicable to automatic machine-made ware.

Shortly prior to the expiration of the time limit, Yardley appealed the decision of the Customs Court and the case now goes to the Court of Customs and Patent Appeals. G.C.M.I. tariff counsel, Barnes, Richardson & Colburn, have made application for the right to file a brief and to participate in the oral arguments in the appeals proceedings. In behalf of the domestic industry, G.C.M.I. has been *amicus curiae* in assisting the Government in the preparation of the case.

Under the direction of the West Coast Subcommittee, it was reported by Mr. DeMerell that the secretary has responded to a request from one of the State Universities for consultation regarding the feasibility and usefulness of a course in glass technology at that institution. He has also delivered a paper covering the packing of processed foods in glass to the Annual Canners and Freezers School of the Department of Food Technology of one of the State Colleges.

Labor Relations

Ralph A. Lind, Secretary of the Committee on Labor Relations, supplemented orally the Committee's written report submitted by its Chairman, Louis C. Roche of Maryland Glass Corporation.

Mr. Lind highlighted the work of the Committee for the past six months and the current schedule of activities.

Glass Packed Products

The report of the Technical Committee on Glass Packed Products submitted by its Chairman Alex Hart, of the Anchor Hocking Glass Corporation, briefly described the meetings of his committee which were held for the purpose of reviewing the progress being made in the studies of asceptic canning for glass packed products.

Mr. Hart further stated that good progress was being made in the research work on various glass packed foods being carried on under the regular Fellowship Program and the expanded program on baby foods at the University of Massachusetts.

Standards for Finishes

Chairman J. D. Laird of the Owens-Illinois Glass Company reported that various subcommittees had followed through on the assignments mentioned in his Committee's report to the Board of Trustees in October 1951. Mr. Laird further reported that there had been general discussions on two new glass finishes and on which he submitted details.

Container Design

Glenn A. Mengle, Brockway Glass Company and Committee Chairman on Container Design and Specifications, reported that there had been a few personnel changes of the Committee. G. F. Rieman, Ball Brothers Company, had replaced P. W. Hatch, and J. S. Algeo of Hazel-Atlas Glass Company had been appointed as an additional member.

Accompanying the parent committee's report by Mr. Mengle were those of subcommittee chairmen R. E. Delaplane, Owens-Illinois Glass Company, on beer bottles, and W. A. Seger, Buck Glass Company, who presides as Chairman of the Milk Bottle Subcommittee.

The work of the West Coast Subcommittee in the field of Container Design and Specifications, including its interest in an engineering program for efficient bottling lines for the One-Way Beer Bottle, was described in some detail.

Package Design

Raymond Wells, Armstrong Cork Company and Chairman of the Committee on Package Design and Specifications, in his report told the Trustees that since the last G.C.M.I. meeting in November 1951, his committee had prepared and distributed to the industry two bulletins on subjects considered to be of widespread interest.

Committee Bulletin No. 6, entitled "Glossary of Fiberboard and Fiber Box Terms," was compiled from many sources by the Package Design Committee in an effort to have a short glossary which would define fiberboard and fiber box terms with the connotations used and understood by the packaging engineers in the glass container industry. The Package Design Committee felt that the Glossary should be helpful to those in each glass container company who are responsible for fiber box purchases or

(*Continued on page* 324)

DR. E. U. CONDON COMMENTS ON—
THE ANNEALING OF FLAT GLASS

The Editor
The Glass Industry
Dear Sir:

The object of this letter is to call attention to an interesting property of the data contained in the translation of a paper by Boris Daragan (Glass Industry, *33*, 69 (1952)) in your February issue. The measurements refer to the slow changes in density occurring when a glass was held at constant temperatures within the transformation region. A glance at the curves of Figure 2 (loc. cit.) shows that the density approaches its equilibrium value in a way that qualitatively resembles an exponential curve.

When the data were plotted on semi-logarithmic paper to test whether the variation is truly exponential it quickly became apparent that the variation of density with time requires for its representation the sum of several exponential terms with different relaxation times. This is shown in Figure 1 of this letter. In the upper curve, the data from Daragan's paper for the density change on annealing at 490°C. are plotted. For this case, the density changed from 2.5176 after five minutes of annealing to an apparent equilibrium value 102 x 10^{-4} greater after some 36600 minutes of annealing. The latter part of the curve is a straight line, indicating that the long-term part of the data can be represented (in units of 10^{-4} gr/cm^3) by the term, 21 $e^{-t/17000}$ where t is the time in minutes. After subtracting out this long-term part, the rest was replotted on a more open time scale in the lower part of Figure 1. Again, it is evident that the curve straightens out at the longer times indicating that another component of the time variation may be represented by 21 $e^{-t/3000}$. Repeating the process of subtracting off this term and replotting (top curve of Figure 2) it is seen that there is another component that is representable as 32 $e^{-t/375}$, and finally the remainder (lower curve of Figure 2) is representable as 28 $e^{-t/29}$. Thus the complete expression for Δ d, the change in density with time is $\Delta d = 28\ e^{-t/29} + 32\ e^{-t/375} + 21\ e^{-t/3000} + 21\ e^{-t/17000}$.

The graphical process by which these relaxation times and their respective amplitudes are determined is not very accurate and another such analysis with rather different constants might represent the data equally well. But it does seem clear that the process of density change with time is definitely shown to be well-represented by several exponential terms with widely different time constants. This suggests that the observed density change is really the composite of a number (in this case, four) of distinct kinds of structural change, each having a characteristic relaxation time of its own.

A similar analysis was made of the density change data for other temperatures (Table II, loc. cit.) and also of the stress release data showing the rate of decay of the birefringence (Table III, loc. cit.) In each case, the curves were found to be representable as the sum of

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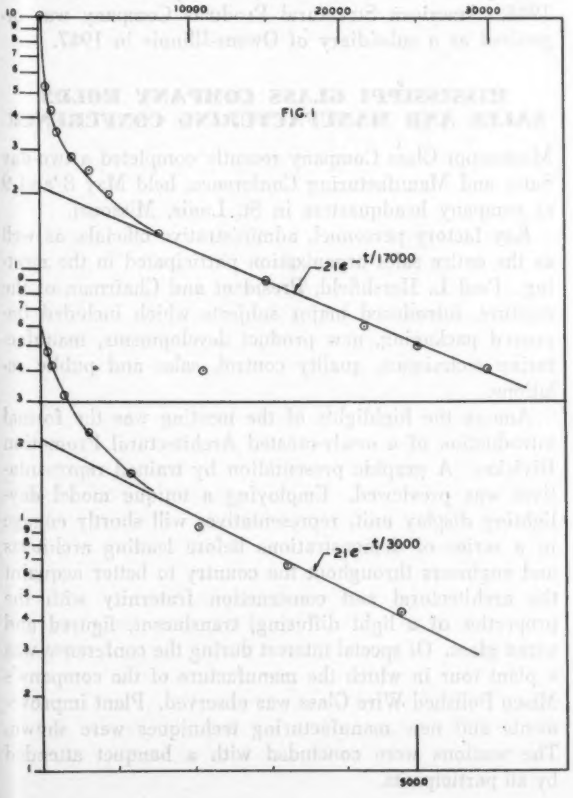
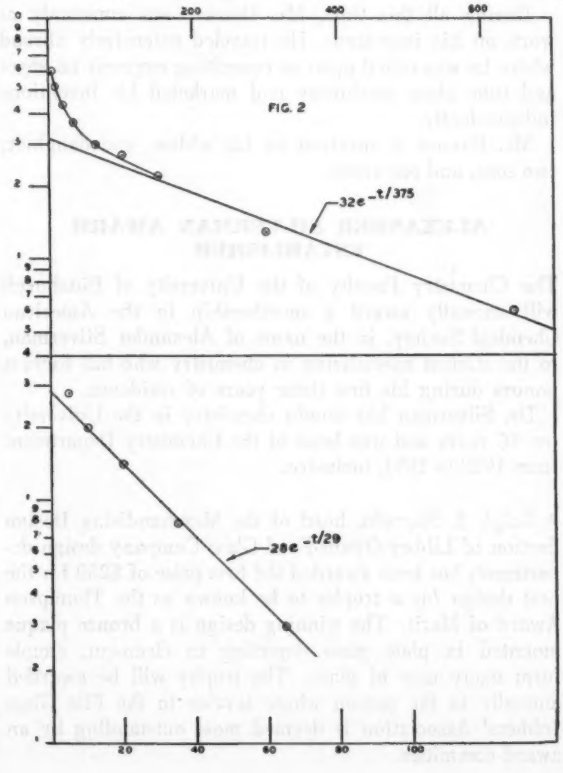




EDWARD DANNER, GLASS EXPERT AND INVENTOR, DIES AT 69

The death of Edward Danner at the age of 69 came suddenly on May 12, 1952, following a lifetime devoted to the glass industry. Mr. Danner was the inventor of the first glass tube drawing machine in the world which was used to make all kinds of tubing used in lighting and in chemical ware.

In 1941, according to official announcement of the U.S. Patent Office, Mr. Danner filed application for the patent on an apparatus for forming glass tubing and rods, which patent examiners ruled was different in six respects from anything previously patented or known. Again in 1943, he made application on a glassware forming apparatus and in 1943 made claim for tubular glassware. In 1945 he added 14 new ideas to the invention. Five years ago he developed a new machine and in all held 39 patents.

Mr. Danner moved to Newark, Ohio, from Toledo where he had been associated with the Libbey Glass Company. He also had been in the employ of Ford Motor Company. He was later connected with the National Plate Glass Company, Division of General Motors Corporation, in the development of sheet glass machinery. Around 1933 or 1935, Mr. Danner was employed by the Corning Glass Works as consulting engineer.

During all this time, Mr. Danner was constantly at work on his inventions. He traveled extensively abroad where he was called upon as consulting engineer on sheet and tube glass machinery and marketed his inventions independently.

Mr. Danner is survived by his widow, one daughter, two sons, and one sister.

ALEXANDER SILVERMAN AWARD ESTABLISHED

The Chemistry Faculty of the University of Pittsburgh will annually award a membership in the American Chemical Society, in the name of Alexander Silverman, to the student specializing in chemistry who has highest honors during his first three years of residence.

Dr. Silverman has taught chemistry in the University for 46 years and was head of the Chemistry Department from 1918 to 1951, inclusive.

• Ralph J. Sherwin, head of the Merchandising Design Section of Libbey-Owens-Ford Glass Company design department, has been awarded the first prize of $250 for the best design for a trophy to be known as the Thompson Award of Merit. The winning design is a bronze plaque mounted in plate glass depicting in clean-cut, simple form many uses of glass. The trophy will be awarded annually to the person whose service to the Flat Glass Jobbers' Association is deemed most outstanding by an award committee.

AMERICAN STRUCTURAL AND KIMBLE COMBINED BY OWENS-ILLINOIS

Owens-Illinois Glass Company has announced that its subsidiary, American Structural Products Company, has changed its name to Kimble Glass Company and on June 1 acquired the business and assets of the company's Kimble Glass Division. Net assets of the subsidiary will then total more than $20,000,000.

The Kimble Division produces glass tubing and rod, scientific laboratory glassware and container specialties at plants in Vineland, N. J., Chicago Heights, Ill., Warsaw, Ind. and Toledo, O. American Structural Products Company makes glass television and radar bulbs, glass insulators for communication and power lines and glass block for the building industry at plants in Columbus, Ohio and Muncie, Ind.

Carl R. Megowen, President of Owens-Illinois, said that the move will increase the efficiency of operation in two elements of the business that have worked for years under the same management and in closely related markets.

"It will bring together our production facilities serving the television and electronic industries and facilitate company's growth in those areas so important to America's defense and industrial development," said Mr. Megowen. There will be no reduction of personnel in either of the two units which together have more than 5,000 employees.

Stanley J. McGiveran, Vice President of Owens-Illinois, who is presently General Manager of Kimble Glass Division and President of American Structural Products Company, will be President of the subsidiary.

The original Kimble Glass Company was formed in Chicago in 1901 and was acquired by Owens-Illinois in 1946. American Structural Products Company was organized as a subsidiary of Owens-Illinois in 1947.

MISSISSIPPI GLASS COMPANY HOLDS SALES AND MANUFACTURING CONFERENCE

Mississippi Glass Company recently completed a two-day Sales and Manufacturing Conference, held May 8 and 9 at company headquarters in St. Louis, Missouri.

Key factory personnel, administrative officials, as well as the entire sales organization participated in the meeting. Paul L. Hershfield, President and Chairman of the meeting, introduced major subjects which included improved packaging, new product developments, manufacturing techniques, quality control, sales and public relations.

Among the highlights of the meeting was the formal introduction of a newly-created Architectural Promotion Division. A graphic presentation by trained representatives was previewed. Employing a unique model daylighting display unit, representatives will shortly engage in a series of demonstrations before leading architects and engineers throughout the country to better acquaint the architectural and construction fraternity with the properties of a light diffusing, translucent, figured and wired glass. Of special interest during the conference was a plant tour in which the manufacture of the company's Misco Polished Wire Glass was observed. Plant improvements and new manufacturing techniques were shown. The sessions were concluded with a banquet attended by all participants.

Inventions and Inventors

Feeding and Forming

Bulb Machine. Fig. 1. Patent No. 2,593,771. Filed Apr. 17, 1946. Issued Apr. 22, 1952. Five sheets of drawings. Assigned to Westinghouse Electric Corporation by Alfred H. Laidig.

This invention is an improvement over that shown in Patent No. 2,393,265 to Richardson, et al. A continuous stream of glass 249 flows from a furnace into the upper portion 126 and at the proper time, it is severed by the action of a roller 254 which also transfers the oncoming stream to the next mold. The bottom of the mold 126 is closed by a sliding plate 181 against which it is pressed by a plunger. The plate 181 is withdrawn and the glass is further pressed and then blown into the mold halves 131 and 132.

The drawings disclose many novel mechanisms for the control and adjustment of the operations which can be learned only by a study of the patent.

The patent contains six claims and 13 references were cited.

Corning Glass Feeder. Fig. 2. Patent No. 2,594,125. Filed May 18, 1950. Issued Apr. 22, 1952. Two sheets of drawings. Assigned to Corning Glass Works by J. D. Clark and G. J. Montopoli.

This feeder is of particular use where the tank capacity is not sufficient for the desired production or where the forming machine is too slow for normal operation. The invention is an improvement on Peiler Patent No. 1,760,-354.

These inventors have discovered that gobs may be fed at widely spaced times without allowing the glass to flow during the interval but instead flushes out the chilled glass which accumulates during the dwell. This avoids a large waste of glass.

When the plunger 12 is in its down position as shown, practically no glass flows from the outlet 21. As soon as the plunger has been raised, a timing device, including the arms 48 and 49, allows a limited amount of glass to flow to clear the orifice. This glass goes to cullet upon being severed by the shears 23 and 23'. The cullet chute then moves out of the way and a gob of glass is severed which goes to the mold.

The patent contains nine claims and the references cited were 1,720,496, Tremblay, July 9, 1929; 2,012,583, Bates, Aug. 27, 1935; 2,077,147, Honiss, Apr. 13, 1937; 2,126,-351, Sharp, Aug. 9, 1938; and 2,280,036, Meyers, Apr. 14, 1942.

Corning Feeder. Patent No. 2,593,499, Filed Mar. 11, 1949. Issued Apr. 22, 1952. Two sheets of drawings, none reproduced. Assigned to Corning Glass Works by Roy N. Sundstrom.

The general object of this invention is the same as that of the Corning feeder noted above; that is, it provides a feeder for operation where the tank has insufficient output or where speed of operation of the associated forming machine is too slow for the usual feeder. It is well-known that a feeder outlet cannot be closed by the plunger for any length of time in order to slow up production. The feeder shown in the patent is of about the usual construction but the operating mechanism is quite different.

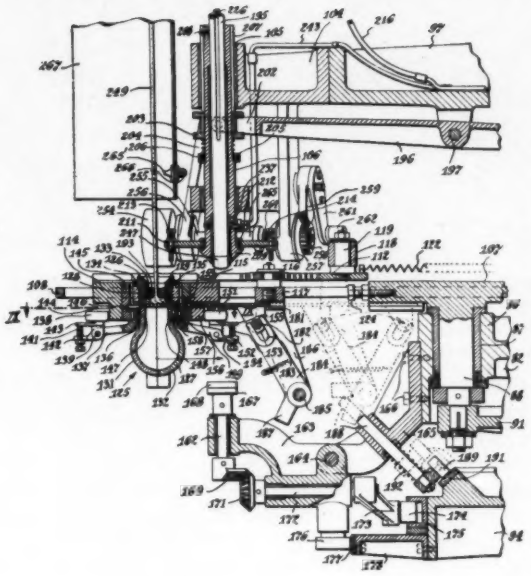


Fig. 1. Bulb Machine.

Claim 1 of the patent defines the invention as follows: the method which comprises flowing a small cross-section stream of molten glass from a supply body into an unconfined space, periodically increasing the cross-section of the stream to form a gob therein, and severing the stream at the point of formation of the gob immediately preceding and immediately following formation of the gob therein.

The patent contains five claims and the references cited were 1,525,189, Lorenz, Feb. 3, 1925; 1,628,238, Ferngren, May 10, 1927; 1,760,254, Peiler, May 27, 1930; and 2,077,147, Honiss, Apr. 13, 1937.

Emhart Slow Speed Feeder. Fig. 3. Patent No. 2,596,-042. Filed Jan. 10, 1950. Issued May 6, 1952. One sheet of drawings. Assigned to Emhart Manufacturing Company by Robert H. Park.

It is well-known that the usual commercial glass feeder cannot be slowed down beyond the point where it loses control of the flowing glass. This inventor provides a slow speed feeder by the use of an orifice ring having flow-retarding baffles in contact with the glass.

The figure shows an orifice ring 4 having a flow-retarding baffle 12 composed of four arms 13 spaced 90 degrees apart. This is made of thin metal such as platinum alloy. The baffle is held in position by extending tabs 19a which are bent down into radial slots 20 in the orifice ring. This device does not interfere with the operation of the plunger and by its use, the speed of the feeder may be slowed down to approximately one-half of the minimum speed possible without it.

The patent contains five claims and the references cited were 2,212,528, Slayter, Aug. 27, 1940; 2,335,135, Staelin, Nov. 23, 1943; 2,462,805, Danner, Feb. 22, 1949; 2, 486,-737, Danner, Nov. 1, 1949; and 381,582, Great Britain, Sept. 29, 1932.

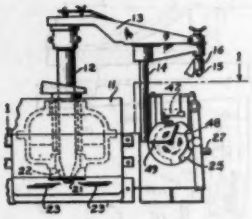


Fig. 2. Corning Glass Feeder.

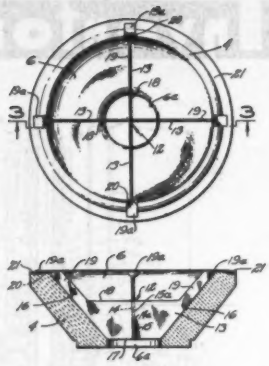


Fig. 3. Emhart Slow Speed Feeder.

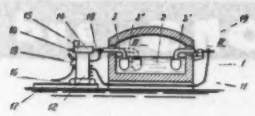


Fig. 4. Electric Melting Furnace.

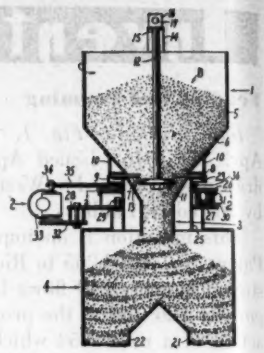


Fig. 5. Batch Feeder.

Furnaces

Electric Melting Furnace. Fig. 4. Patent No. 2,591,708. Filed Aug. 21, 1948. Issued April 8, 1952. Two sheets of drawings. Eugenio Lubatti, Turin, Italy, inventor.

This is an electric melting furnace in which the electrodes project through the furnace wall above the glass level so that they may be moved laterally in the glass bath or removed without tearing down the furnace. The figure shows two electrodes 3 and 3′ which may be duplicated as required. The electrode 3 is carried by a transformer 12 mounted on wheels for movement toward and from the furnace. The other electrode 3′ is connected to the transformer by a cable 11 and this is also adjustable. Water cooling means are provided for the electrodes and their connections. The openings 19 in the furnace walls are closed after the electrode is positioned.

The patent contains one claim and 16 references were cited.

Batch Feeder. Fig. 5. Patent No. 2,593,535. Filed Apr. 12, 1946. Issued Apr. 22, 1952. One sheet of drawings. Assigned to Emhart Manufacturing Company by Madison M. Cannon.

This batch feeder is intended to prevent segregation of the batch materials during delivery to the melting furnace. The figure shows a batch bucket 1 which can be placed on a rotating mechanism 2 so that the batch can be delivered by a spout 3 to a hopper 4. A valve 11 controls the discharge from the bucket 1 to the hopper 4. Thus the batch is laid in a series of circular layers in the hopper 4 and when it is delivered from the hopper outlets 21 and 22, the composition will be uniform and there will be no segregation.

The patent contains three claims and 11 references were cited.

Electric Furnace. Fig. 6. Patent No. 2,594,972. Filed June 15, 1949. Issued Apr. 29, 1952. Two sheets of drawings. Assigned to Fostoria Glass Company by George T. Muehlenkamp.

This furnace is particularly adapted for intermittent use instead of continuous use with glass feeders. The figure is a vertical section through a circular furnace having walls 11 and an opening 14 for the introduction of batch and taking out the molten glass. There are three electrodes equally spaced in the bottom, two of these being shown at 15 and 16. The curved surfaces of the electrodes prevent the precipitation of lead thereon. Each electrode is formed in an individual block and surrounded by a well 27 to collect lead during the melting. This can be drawn off through a channel closed by a plug 31. Pipes 28 and 32 provide cooling means. Three-phase current is connected to the electrodes at 26.

The patent contains 17 claims and 14 references were cited.

Electric Furnace. Fig. 7. Patent No. 2,594,973. Filed Sept. 9, 1949. Issued Apr. 29, 1952. One sheet of drawings. Assigned to Fostoria Glass Company by G. T. Muehlenkamp.

This patent is by the same inventor and assigned to the same company as the preceding. It discloses three electrodes spaced 120 degrees apart in the floor of a circular refractory tank, one of these being shown in section in the figure. The electrodes are square with a diagonal positioned on a radius of the tank. Each of these comprises a molybdenum cup 15 set in a well 14 below the level of the tank floor and containing a quantity of lead 21 which is molten during operation. A conductor 19 which may be cooled is connected to each cup and extends through the floor where it is connected to a source of power.

The patent contains three claims and the references cited were 1,542,716, Payne, June 16, 1925; 1,878,591, McIntosh, Sept. 20, 1932; 2,000,278, Ferguson, May 7, 1935; 2,007,755, Ferguson, July 9, 1935; 2,014,615, Ferguson, Sept. 17, 1935; 2,244,267, Slayter et al., June 3, 1947; 2,512,206, Holden, June 20, 1950; and 14,858, Great Britain of 1909.

Miscellaneous Processes

Glass Inspecting Device. Fig. 8. Patent No. 2,593,127. Filed Jan. 24, 1950. Issued Apr. 15, 1952. Three sheets of drawings. Assigned to Owens-Illinois Glass Company by William J. Fedorchak.

The object of this invention is to provide means for detecting imperfections such as stones, seeds, spikes, etc., in or on the walls of glass bottles and similar ware. The machine is of the turret type capable of inspecting bottles in rapid succession. The testing unit shown in the figure comprises an arc light 5 which projects a beam 6 through lenses 7, against a mirror 8 and then to a rotating octagon mirror or reflector 9 which directs the light against the jar 11. This beam is focused near its focal point at 14 on the opposite inside wall. This beam moves vertically through the full length of the inside wall 13.

When a flaw is encountered by the beam, the light is reflected so that it passes through collecting lenses 16 and

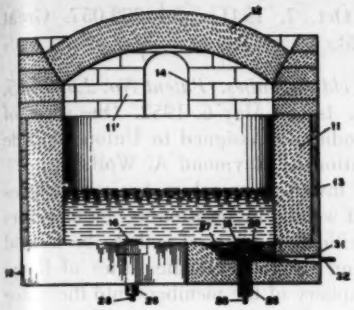


Fig. 6. Electric Furnace.

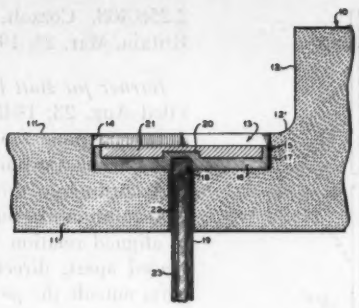


Fig. 7. Electric Furnace.

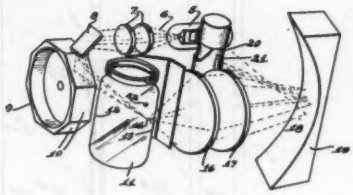


Fig. 8. Glass Inspecting Device.

17 and against a concave mirror 19. This in turn reflects the light to a photoelectric cell 20 which throws an ejector mechanism into operation to discard the jar. Similar means is provided to inspect the bottom of the ware.

There are 11 claims in the patent on the apparatus and method. The references cited were 2,265,037, Gulliksen, Dec. 2, 1941; 2,286,836, Sachtleben, June 16, 1942; 2,318,856, Hoffman, May 11, 1943; 2,426,355, Kellogg, Aug. 26, 1947; and 2,481,863, Owens, Sept. 13, 1949.

Bottle Inspecting Apparatus. Fig. 9. Patent No. 2,593,-311. Filed Apr. 3, 1948. Issued Apr. 15, 1952. Two sheets of drawings. Assigned to Watson D. Harbaugh, Evanston, Ill., by P. M. Johnson and L. M. Hinrichs.

This machine is capable of inspecting bottles having embossed surfaces or permanent labels, preferably just before filling, and repecting any that have foreign bodies there-in. The machine includes a pair of elevators 11 and 12 enclosed in a tank-like structure and connected by a horizontal chamber 13 and filled with a "rinsing liquid" as indicated. The elevator 11 at the right of the figure lowers the bottles into the liquid while vibrating them to jar bubbles loose from the inside of the bottles.

The bottles are filled with the liquid as they go down and a pusher mechanism moves them into the chamber 13. This chamber includes germicidal lamps 38 and a refrigerating coil 39 which increases the refractive index of the liquid. At the inspection station 27 there is a light source 52 and a photo-electric cell and amplifier 53. This sets a reject mechanism in case any foreign matter is encountered by the light. It is specified that the liquid shall have an index of refraction of at least 1.333. The bottles are elevated and emptied by the elevator 12 and then go to the filling machine.

The patent contains six claims and 17 references were cited.

Glass Cutting Board. Patent No. 2,591,828. Filed Oct. 7, 1949. Issued Apr. 8, 1952. One sheet of drawings, none reproduced. Assigned to The Fletcher-Terry Company by Chester K. Judd, Jr.

This is a board to support flat glass during the cutting operation having a track to guide the cutter, means for clamping the glass sheet on the board and a breaker member to sever the sheet along the score line made by the cutter. One advantage of this board is that it can be used with cutting tools of standard design.

The patent has seven claims and the references cited were 1,117,735, Whittemore, Nov. 17, 1914; 1,697,044, Burda, Jan. 1, 1929; 1,755,365, Rowley, Apr. 22, 1930; and 33,821, France, 1928.

Tube Bending Device. Patent No. 2,593,854. Filed Apr. 10, 1951. Issued Apr. 22, 1952. Two sheets of drawings, none reproduced. Assigned to General Electric Company by Paul A. Dell.

This device is particularly adapted for making U-shaped bends such as are used in repeating flash tubes, for example. Burners are provided to soften the tube after which a foot treadle is operated to make the bend. It can be adjusted to take tubes of different diameters and to make bends of different radii.

The patent contains five claims and no references were cited by the Patent Office.

Vacuum Flask Sealing Machine. Patent No. 2,593,999. Filed Oct. 1, 1949. Issued Apr. 22, 1952. Five sheets of drawings, none reproduced. Charles Eisler, inventor.

This is a machine for forming vacuum flasks by joining the inner flask and outer blank. The machine has 12 heads which travel through an equal number of working stations. At the first station the parts are loaded after which they are centered and moved into proper relative position. At succeeding stations the parts to be sealed are heated and formed by shaping rollers to make the final vacuum bottle which is then annealed. All of the operations, after loading, are automatic.

The patent contains two claims and references cited were 852,099, Bock, Apr. 30, 1907; 1,242,837, Moberg, Oct. 9, 1917; 1,674,182, Siegheim, June 19, 1928; 1,755,-307, Rohl, Apr. 22, 1930; 1,786,456, Rohl, Dec. 30, 1930; 1,869,533, Wetmore, Aug. 2, 1932; 2,102,357, Dichter, Dec. 14, 1937; and 358,949, Great Britain, Apr. 8, 1930.

Loading Stop for Sealex Machines. Patent No. 2,595,-058. Filed Sept. 30, 1949. Issued Apr. 29, 1952. One

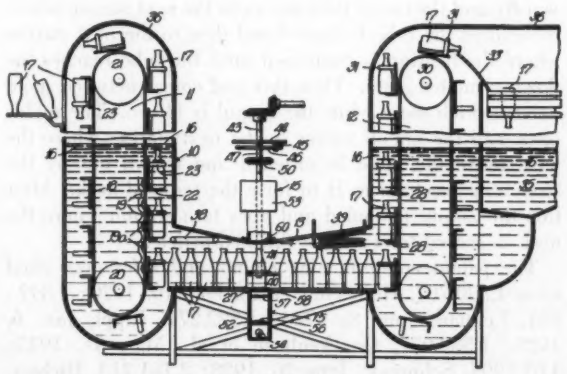


Fig. 9. Bottle Inspecting Apparatus.

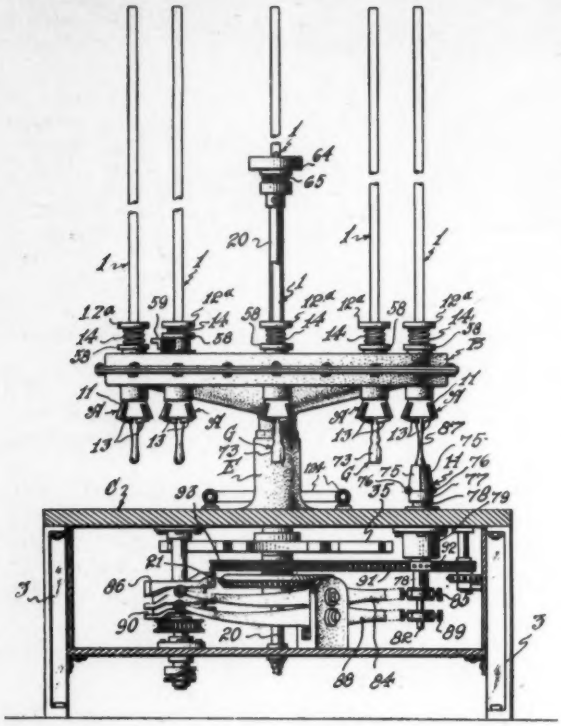


Fig. 10. Ampul Machine.

sheet of drawings, none reproduced. Assigned to Radio Corporation of America by Charles W. Daley.

This is a stop for positioning bulbs in a Sealex machine by which the envelope parts of electron tubes are sealed and exhausted. By the use of this device the parts may be more rapidly and accurately assembled.

The patent contains nine claims and the references cited were 2,100,656, Donovan et al., Nov. 30, 1937; 2,296,579, Seelen, Sept. 22, 1942; and 2,447,568, Eisler, Aug. 24, 1948.

Ampul Machine. Fig. 10. Patent No. 2,595,077. Filed June 17, 1948. Issued Apr. 29, 1952. Seven sheets of drawings. Assigned to Hughes-Murray, Inc., Newark, N. J., by Floyd H. Hughes and Gregory J. Murray.

The machine comprises a turret having eight holders or chucks A for holding the glass tubes 1 from which the ampuls are made. The proper length of tube is fed downwardly and the turret then moves to the next station where the end of the tube is heated and then to the next station where the heating is continued until the tube reaches the flowing molten state. Then this end comes between mold halves which close while the ampul is blown. The molds open and the ampul moves to the next station where the part above the mold is softened and drawn out by the stretching mechanism H to form the reduced neck. After this the ampul is cooled and goes to a station where the neck is scored to sever the finished article.

The patent contains nine claims and references cited were 1,330,707, Hoffstetter et al., Feb. 10, 1920; 1,342,821, Leiman, June 8, 1920; 1,522,271, Rippl, Jan. 6, 1925; 1,532,077, Quackenbush et al., Mar. 31, 1935; 1,674,997, Schmunk, June 26, 1928; 2,101,213, Dichter, Dec. 7, 1937; 2,235,515, Carpenter, Mar. 18, 1941; 2,258,408, Cozzoli, Oct. 7, 1941; and 282,057, Great Britain, Mar. 22, 1928.

Burner for Butt Welding Tubes. Patent No. 2,595,555. Filed Aug. 23, 1948. Issued May 6, 1952. One sheet of drawings, none reproduced. Assigned to Union Carbide and Carbon Corporation by Raymond A. Wolf.

According to this invention members having surfaces of revolution are butt welded by positioning the members in aligned relation with their opposed ends to be welded spaced apart, directing from an arcuate series of flame ports outside the periphery of the members into the space between the opposed ends thereof a series of coplanar oxy-fuel converging to a point beyond the periphery of said members and opposite said flame ports whereby the fishtail caused by impact of the several flames is outside the periphery of said members, and moving said members toward each other to contact said heated ends until said molten end coalesce.

The patent contains two claims and references cited were 1,775,311, Halle, Sept. 9, 1930; 2,194,755, Kell, Mar. 26, 1940; 2,252,320, Hughey, Aug. 12, 1941; 2,306,054, Guyer, Dec. 22, 1942; 2,323,182, Stuckert, June 29, 1943; 2,438,170, Hughey, Mar. 23, 1948; 2,447,569, Eisler, Aug. 24, 1948; and 205,885, Germany, July 31, 1907.

Glass Cutter. Patent No. 2,595,862. Filed March 24, 1949. Issued May 6, 1952. One sheet of drawings, none reproduced. Assigned to Verticraft Mfg. Corporation, Chicago, Ill., by Edward J. Lavander.

This is a frame and guide for use in cutting flat glass. It includes a clamping member which will accommodate different thicknesses of glass and a pivoted breaking arm that makes contact along the entire length of the break to be made.

The patent contains five claims and the only reference cited was 2,254,541, Nordgren dated Sept. 2, 1941.

HARLAN HOBBS TO HEAD S.A.M.A. PROGRAM

Harlan Hobbs, Manager of sales promotion and advertising for Kimble Glass Division of Owens-Illinois Glass Company, has been appointed to head the Public Information Program of the Scientific Association Makers Association, according to a recent announcement.

MATHEMATICAL SERVICE ORGANIZED

Due to the increasing importance of mathematical methods in the field of optics, a group has been organized which is devoted exclusively to applied mathematics.

Known as Mathematical Computing Service, the group specializes in performing services for industries and universities desiring engineering calculations of a high degree of complexity and the treatment of related mathematical problems in the field of optics. An important function of the group is the mathematical formulation and complete solution of a problem from given physical data.

The staff consists of consultants holding Doctorate Degrees who are qualified to treat problems in applied mathematics related to the physical sciences.

New Ideas About Hoppers

Commonplace as they may seem, hoppers or bins play an important part in the over-all glasshouse picture. When used for raw material storage, a hopper must not only protect the material stored therein, but must also allow its free delivery to the weighing point, and in such a manner that the material that was put in last month is delivered before the material that was put in last week. When used for the storage and delivery of mixed glass batch to and for the furnace, the primary requirement is that they deliver the material as a completely mixed unit without undue segregation or separation of the batch materials.

C. A. Lee in the April 1952 issue of *Chemical Engineering* states that a hopper is a bin with bottom plates so sloped that material will slide towards the outlet. When one speaks of a straight side, what is meant is that one bottom plate is vertical and merely a continuation of one of the sides of a rectangular hopper. That side is in line with the gate.

Considerable difference of opinion and confusion exists on the part of designers and users of hoppers. For example, the following opinions have been expressed: (1) Don't make the slopes too steep as then the material will wedge and pack in the narrow angle. Make the slope flat enough so that arch action in the body of the material will support the weight and keep pressure from building up on the material beneath it. (2) To avoid segregation, make the slopes steep so that material on sloping sides will be pushed out uniformly by the material above. (3) Provide at least one straight side as material can't arch against a vertical surface.

Lee states that none of the above opinions have a sound theoretical basis. Take, for example, the third common idea about hoppers: having at least one straight side is, at first thought, a very desirable and sound feature even though some storage capacity is sacrificed. The thought behind this is that arching is inconsequential against a vertical surface. If this idea were correct, an easy way to design a hopper would be to use any reasonable shape and install a vertical plate centrally above the gate. Then one would have the equivalent of two hoppers, each with one vertical side. This solution is too simple. It has been tried and did not work.

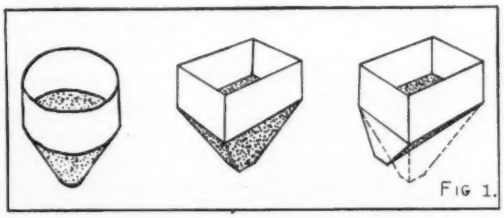
There is an apparent practical basis for this very plausible idea. With a straight side, material does slide down that side and is first to leave. The observer only wishes he could have four straight sides. However, the reason material slides down the straight side is that the subsidence is always vertically above the outlet. The straight side just happens to be there.

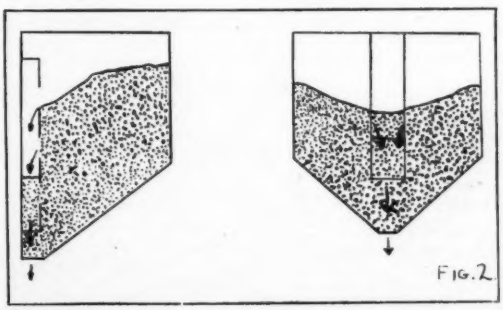
Many different ideas have been tried to prevent arching and facilitate flow of material. One is based on the same idea about the desirability of straight sides (Fig. 2). It involves a vertical chute reaching up towards the surface and feeding to the outlet. Openings in the side take material from different levels. An idea that actually was patented uses an open-end cylinder set somewhat above the gage (and adjustable to suit the material). The idea is that material would slide down the cylinder and that new material would keep feeding to top as required.

Compressed air vibrators have been used successfully for easing the flow of some materials. Vibrators should not be allowed to run except when the gate is open or they will cause packing of the material.

In regards to arch action, the arch is continually reforming during flow. In fact, it could better be described as a set of forces in the shifting material. It is real enough to hold material in place against a sloping bottom while material above the gate is leaving. Action is the same as for the plane of rupture described by Legue in reporting his classic experiments with sand behind a small movable retaining wall. As the wall is moved, a wedge of material behind it slides, not down the angle of

(*Continued on page* 333)





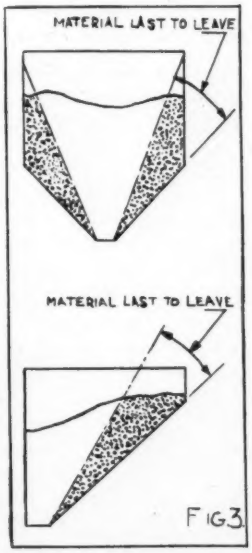


Fig. 1. Common shapes for hoppers. Drawing at right shows a hopper with one straight side (solid lines) and a hopper with two straight sides (dotted lines). Fig. 2. Many attempts have been made to facilitate flow of material from hoppers. Those shown here are based on misconception of the function of straight sides. Fig. 3. Subsidence of material with flow through outlet for two different shapes.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during March 1952 rose to reach a preliminary 139,700 persons. Compared with the adjusted employment figure of 138,400 for February, a rise of .009 per cent is shown. During March 1951 employment was 130,000, or 7.4 per cent below March this year.

Payrolls during March 1952, according to preliminary figures, also rose to reach $40,377,956. This indicates a rise of 2.6 per cent over the $39,306,519 paid out during February. Payrolls during March 1951 were $37,005,367. This is 9.1 per cent below March this year.

Glass container production, based on figures released by the Bureau of Census, rose 1.3 per cent during April 1952 to reach 9,523,038 gross. This is an increase over the 9,399,715 gross produced during March. Production during April 1951 was 11,075,359 gross, or 14 per cent above production during April this year. Total glass container production thus far in 1952 has reached 36,646,264 gross. This is 11.7 per cent less than the 41,541,413 gross produced at the close of the corresponding period in 1951.

Shipments of glass containers during April 1952 are reported to be 9,838,327 gross. This is 6.7 per cent higher than the 9,214,138 gross shipped during March. Shipments of glass containers during April 1951 were 9,847,909 gross. This is only a small fraction of 1 per cent higher than shipments for April this year. Glass container shipments at the close of the first four months of 1952 have reached a total of 35,992,674 gross. This is 7.3 per cent less than the 38,862,479 gross shipped at the close of the corresponding period in 1951.

Stocks on hand at the close of April 1952 are 9,862,648 gross. This is 3.4 per cent less than the 10,215,726 gross on hand at the close of March. Stocks at the end of April 1951 were 9,293,375 gross.

Automatic tumbler and table, kitchen and household glassware: Due to the lateness of one company's report of March activity, data on these types of glassware is not available. It is expected that with the July issue these figures will be brought up-to-date, including corrected figures where necessary.

Pressed and blown glassware: Factory shipments of pressed and blown glassware (except glass containers) totaled $324.9 million in 1951, representing virtually no

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	April 1952
Narrow Neck Containers	
Foods	1,125,217
Medicinal & Health Supplies	1,252,602
Chemicals, Household & Industrial	715,031
Beverages, Returnable	728,765
Beverages, Non-returnable	37,979
Beer, Returnable	230,420
Beer, Non-returnable	469,607
Liquors	749,242
Wines	311,804
Toiletries & Cosmetics	577,889
Sub-total (Narrow)	6,198,556
Wide Mouth Containers	
Foods	*2,302,263
Dairy Products	244,296
Medicinal & Health Supplies	348,856
Chemicals, Household & Industrial	135,456
Toiletries & Cosmetics	175,812
Packers' Tumblers	171,490
Sub-total (Wide)	3,378,173
Total Domestic	9,576,729
Export Shipments	261,598
TOTAL SHIPMENTS	9,838,327

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production April 1952	Stocks April 1952
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries & Cosmetics	Narrow Neck	3,590,906	3,539,849
	Wide Mouth	*2,949,106	*2,868,142
Dairy Products		244,296	315,005
Beverages, Returnable		828,700	835,799
Beverages, Non-returnable		47,110	41,354
Beer, Returnable		247,755	354,846
Beer, Non-returnable		477,887	739,568
Liquors		670,631	765,805
Wines		306,065	283,535
Packers' Tumblers		182,440	118,745
TOTAL		9,523,038	9,862,648

* This figure includes Home Canning.

Table 1.--PRESSED AND BLOWN GLASSWARE (EXCEPT GLASS CONTAINERS): VALUE OF SHIPMENTS BY CLASS OF PRODUCT, 1947-1951

Class of product	Value (thousands of dollars)				
	1947	1948	1949	1950	1951
TOTAL	$233,099	$242,627	$242,418	$324,696	$324,939
Machine-made table, kitchen, art, and novelty glassware	62,455	60,844	63,023	72,493	76,487
Hand-made table, art, and novelty glassware	33,106	34,640	30,737	29,510	31,590
Cooking ware (heat-resistant, heat-treated, and annealed)	19,366	12,062	8,436	10,977	12,550
Lighting glassware	118,172	63,299	76,956	133,268	108,102
All other pressed and blown glassware (except glass containers)		71,782	63,266	78,448	96,210

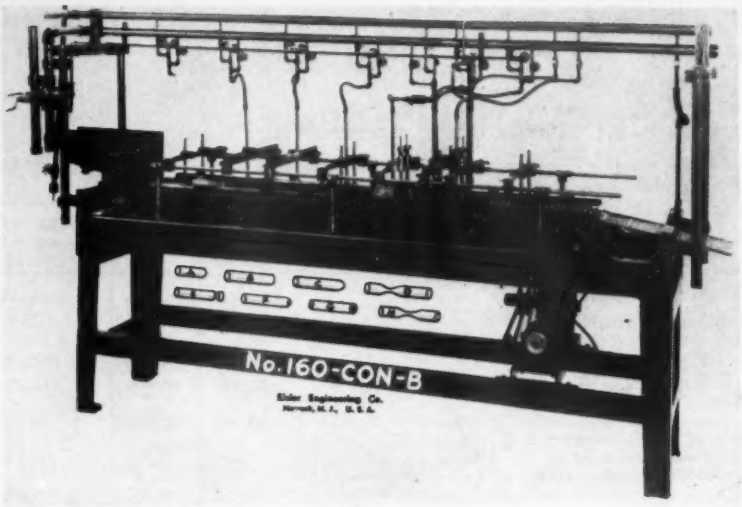
change from 1950, according to data released by the Bureau of Census. Shipments of machine-made table, kitchen, art and novelty glassware in 1951 were valued at $76.5 million, up 6 per cent from 1950; lighting glassware totaled $108.1 million, a 19 per cent decrease from 1950; cooking ware showed a 14 per cent increase and hand-made table, art and novelty glassware increased 7 per cent over 1950. Shipments in 1951 of all other pressed and blown glassware (except glass containers) amounted to $96.2 million, up 23 per cent over 1950.

Table 2.--PRESSED AND BLOWN GLASSWARE (EXCEPT GLASS CONTAINERS): QUANTITY AND VALUE OF SHIPMENTS FOR THE UNITED STATES, 1950 AND 1951

Product	Unit of measure	1951		1950	
		Quantity	Value (thousands of dollars)	Quantity	Value (thousands of dollars)
PRESSED AND BLOWN GLASSWARE (EXCEPT GLASS CONTAINERS), TOTAL	...	...	$324,939	...	$324,696
Machine-made table, kitchen, art and novelty glassware (including glassware made by machines with automatic and semi-automatic feeds), total	...	...	76,487	...	72,493
Tumblers, goblets, and other stemware	M dozen	72,589	40,596	71,884	38,273
Tableware (designed for serving food and drink; excluding tumblers, goblets, and other stemware)	M dozen	26,911	20,960	27,162	19,108
Kitchenware (designed for preparing and storing food in homes and commercial establishments; excluding cooking ware)	M dozen	8,096	10,480	7,769	10,310
Ornamental, decorative, and novelty glassware; and smokers' accessories	M dozen	6,158	4,451	6,350	4,802
Hand-made table, art, and novelty glassware, total	...	...	31,590	...	29,510
Pressed ware:					
Tumblers, goblets, and other stemware	M dozen	464	1,758	512	1,825
Tableware (excluding tumblers, goblets, and other stemware)	M dozen	1,232	9,921	1,111	8,566
Ornamental, decorative, and novelty glassware; and smokers' accessories	...	...	3,599	...	3,378
Blown ware:					
Tumblers	M dozen	661	1,896	645	1,866
Goblets and other stemware	M dozen	1,530	9,883	1,774	10,035
Ornamental, decorative, and novelty glassware; and smokers' accessories (including ornamental tableware)	...	...	4,533	...	3,840
Cooking ware (heat-resistant, heat-treated, and annealed), total	...	...	12,550	...	10,977
Hand- and machine-made coffee and beverage makers (excluding tea kettles)[1]; Machine-made custard cups, cake and bread bakers, casseroles, pie plates, and other machine-made and hand-made cooking ware (including top-of-stove ware)	M pieces	69,444	12,550	54,608	10,977
Lighting glassware, total	...	...	108,102	...	133,268
Bowls, all types	...	...	3,387	...	3,316
Enclosing globes, all types	...	...	3,379	...	3,570
Shades, reflectors, and torcheres	...	...	5,416	...	5,887
Lantern globes (oil and electric)	M dozen	424	967	426	889
Lamp chimneys	M dozen	1,265	1,334	1,317	1,300
Lamp parts	...	...	2,835	...	2,970
Railroad, marine, and traffic lighting glassware	...	...	1,359	...	888
Electrical discharge tubing (including fluorescent and neon)	M linear feet	433,149	7,431	423,104	6,850
Electric-light bulb blanks, electronic-tube blanks (including radio, X-ray, radar, and special tubes), and television-tube blanks and parts	...	...	75,386	...	102,201
Shields and plates for fluorescent lighting fixtures	...	...	6,608	...	434
Other interior and exterior lighting glassware (including oil founts and prisms)	...	...		...	4,963
All other pressed and blown glassware, total	...	...	96,210	...	78,448
Technical and scientific glassware:					
Tubing and cane for electric light bulbs	M pounds	61,980	12,574	70,620	15,972
Tubing (excluding fluorescent and neon); rods and cane, all types (except electrical)	M pounds	20,711	6,482		
Insulators, all types	M pounds	21,294	1,586	...	[2]1,790
Industrial glassware, including gauge glass, instrument faces, machine parts, glass knobs, meter covers, pumps, battery jars, etc.	...	...	15,260	...	11,474
Other pressed and blown glassware:					
Optical instrument lens blanks	...	...	1,468	...	([3])
Machine-made (including glass blocks; scientific and laboratory glassware; other technical glassware; sun-glass lenses and other eye-protective lenses; Christmas-tree ornaments; stationers' ware; marbles; nursery bottles; lantern and searchlight lenses; automotive lenses, including sealed beam; ophthalmic lens blanks, etc.)	...	...	57,617	...	[4]47,434
Hand-made (including kitchenware other than cooking ware, stationers' ware, and nursery bottles)	...	...	1,223	...	1,778

[1]Represents complete units only. Replacement parts are included in other cooking ware.
[2]Represents insulators and other technical glassware.
[3]Included with other machine-made pressed and blown glassware.
[4]Excludes other technical glassware.

New Equipment and Supplies



HIGH-SPEED CONTINUOUS BOTTOMING MACHINE

Eisler Engineering Company, Inc., 750 South 13th Street, Newark 3, N. J., has developed a high-speed automatic bottoming machine for making round or flat bottoms, vials, eye droppers or similar products such as bulbs for radio tubes and telephone lamps.

The machine can be adapted to handle all kinds of glass tubing, soft glass or Pyrex glass from 1/8" to 3/4" diameter and the length of the finished product can be adjusted from 1" to 6". The production output ranges from 8,000 to 16,000 per hour, depending on the tube diameter, wall thickness and the nature of the glass tube products.

The framework with fabricated table and legs carries the driving mechanism, which is powered by a 1/2 HP motor and speed reducer. A series of rotating shafts with glass roller moves continuously, while taking the blank tubing off the automatic hopper feed. The glass tubing is carried in a horizontal position under a row of ribbon burners. These ribbon burners are placed on the bottom and on the top of the glass and the finished product is discharged on the opposite end of the machine. Various other types of glass requiring similar operations can be easily adjusted on the machine.

The operation of the machine is simple. The glass is cut in double length. The operator loads the hopper feed, and the rest of the operations are fully automatic until the products are complete and roll off the machine. One operator can feed 15,000 pieces per hour.

NEW INDUCTANCE BRIDGE RECEIVER

Minneapolis-Honeywell Regulator Company, Brown Instruments Division, Wayne & Windrim Avenues, Philadelphia 44, Pa., has announced a new receiver for measurement and control of flow and liquid level. The new instrument, an Electronik inductance bridge receiver, combines in a single instrument a number of functions which formerly required the use of two instruments.

For example, the new instrument makes it possible to indicate, record, integrate and control flow and liquid level. Data can also be retransmitted pneumatically to a second receiver remotely located. An Indexet mechanism is available to reset the control index from a remotely located transmitter. Incorporation of these functions in one instrument case is an important factor in many applications where conservation of panel space is a vital consideration.

Accurate to within plus or minus 1/2 of 1 per cent of full scale, the instrument combines the time-proven inductance bridge transmission system with the Brown "Continuous Balance System" for power positioning of the pen.

CATALOGS RECEIVED

United Laboratories, Inc., 16801 Euclid Avenue, Cleveland 12, Ohio, has issued a completely new 4-page bulletin describing a dozen different special coatings for plant maintenance.

The new literature describes the use of various industrial products for solving such problems as skidproofing, rust prevention, painting over damp areas, weatherproofing and decoration of exterior masonry, interior waterproofing, painting over hot surfaces, protection against acids, chemical fumes and other special maintenance work. The numerous problems are listed in the folder, followed by brief suggestions as to the solution.

Solvay Sales Division, Allied Chemical & Dye Corporation, Advertising & Sales Promotion Department, 40 Rector Street, New York 6, New York, has announced a new expanded and revised edition of its Technical & Engineering Bulletin No. 5, "Soda Ash—Its Properties, Loading and Unloading, Handling and Storage."

The new 64-page third edition contains both new material and revisions, in addition to the charts and data that were included in the widely circulated previous editions.

Behr-Manning Corporation, Division of Norton Company, Troy, New York, has announced the distribution of an illustrated instructive booklet describing the advantages of coated abrasive belt polishing methods, "How Polisher Pete Put Economy in Polishing."

American Potash & Chemical Corporation, 122 East 42nd Street, New York 17, New York, has published a booklet which tells the story of the film and its principal operations.

The well-illustrated booklet tells the story of the processes developed and their growth, research and development, and the recovery of the products. A plant flow diagram is presented in a simple and effective manner. The booklet also deals with its employee-relations and the town of Trona, California, where the company's principal operation is located.

The Howe Scale Company, Rutland, Vermont, has announced its new 28-page Condensed Scale Catalog Number 11, which features its complete line of modern scales. It includes a selection of a thousand popular standard Howe scales weighing from 1/64th of-an-ounce to 400 tons.

The new catalog includes complete specifications, spot illustrations and essential information. A simple index makes it easy to find any scale. The catalog is conveniently arranged by types of weight indication, featuring the Howe scales with beam indication, tape-drive dial, Weightograph projection and the Teleprint electronic remote weight recorder.

Foote Mineral Company, 18 West Chelten Avenue, Philadelphia 44, Pa., has made available a new 40-page booklet, "Lithium in Modern Ceramics."

The booklet is devoted to Lithium—its character, occurrence, use and bibliography related to ceramics.

Metallizing Engineering Company, Inc., 38-14 30th Street, Long Island City 1, New York, has recently published a new metallizing handbook. The 250-page text, a completely new work, is profusely illustrated with photographs, diagrams, and charts.

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JOHN GAYNER, PRESIDENT OF GAYNER GLASS WORKS, DIES

John Miller Gayner, President of the Gayner Glass Works, died after a protracted illness on May 15 at the age of 71. He had been a patient at the Hospital of the University of Pennsylvania in Philadelphia.

Mr. Gayner represented the third generation of his family to head the glass company, succeeding his father, E. J. Gayner, to the presidency in 1937. The company was founded by John Gayner in 1874.

In addition to serving as president of his company, Mr. Gayner was active in may philathropic groups. He was a member of the New Jersey Methodist Conference Board of Education, a Director of the West Jersey and Seashore R.R., Past President of the Salem Rotary Club, a 32nd Degree Mason and a member of the Shrine and Knights Templer. Mr. Gayner was City Councilman in Salem for eight years and its Mayor from 1926 to 1929.

Surviving Mr. Gayner are his wife, Greta F.; two sons, Edward J. and Lewis F.; a daughter; his brother, Joseph F.; and four sisters.

ASSOCIATION FOR GLASSWARE INDUSTRY FOUNDED NINETY YEARS AGO

On May 30, 1952, the American glassware industry will take note of the 90th anniversary of the founding of an association representing its members. Existing records show that the first recorded meeting of a glass manufacturers association was held at the Astor House in New York City on May 30, 1862. This earlier Association was called "The Flint and Lime Glass Manufacturers of East and West." At that time May 30th was just another day of the Civil War period, but it later was to become Memorial Day and a national holiday.

Another meeting was held the next year in Pittsburgh on June 4, 1863 when the name was changed to "The U. S. Flint Glass Association." Annual meetings were held thereafter. The object of the early Association was to improve industry conditions both for employer and employee, an objective which has been perpetuated to this day in all glass manufacturers organizations.

The name of the Association was again changed at a meeting in Pittsburgh at the 28th Ward Schoolhouse on December 11, 1874 to "The Western Flint and Lime Glass Protective Association." Among the earlier membership of this Association appear the names of some of the companies that exist today: McKee Brothers, Rodefer Brothers, George A. Macbeth Company now part of Corning Glass Works, Phoenix Glass Company, Gill Brothers & Company, Gillinder & Sons. Many of these companies are being managed today by the second and third generation of their pioneer founders.

On January 5, 1887 the name was again changed to "The American Association of Flint and Lime Glass Manufacturers." In 1928 it became the "American Glassware Manufacturers, Inc." This latter Association name in 1934 was changed to "American Glassware Association" which is the present organization whose membership comprises more than 75 per cent by volume of the entire Pressed and Blown Glassware Industry.

The glassware industry can proudly point to the fact that it is one of the oldest organized industries in the U. S. since few manufacturing groups can point to continuous organization for 90 years. During this time the industry has seen many changes but it has continuously grown in importance, due in no small degree to the fact that it has been organized and followed a predetermined and guided pattern that has been developed by all manufacturers in the industry.

BALL BROTHERS APPOINTMENTS

The appointment of Kenneth M. Hay as Sales Manager of the Commercial Glass Container Division for Ball Brothers Company has been announced by James L. Knipe, Ball Vice President and General Sales Manager.

For the last eight years Mr. Hay has been associated with the Thatcher Glass Manufacturing Company in a sales executive position, and prior to that was associated with C.I.T. Corporation as assistant vice president. Mr. Hay is a native of Buffalo, New York, and graduated from the University of Buffalo.

Mr. Knipe also announced the advancement of Everett E. Ester to a new position as Ball field sales manager. Mr. Ester, who has been with the company's Commercial Container Sales Division since 1945, had been acting manager of the Division since January.

THATCHER GLASS ANNOUNCES CHANGES

In line with its continuing policy of expansion, the Thatcher Glass Manufacturing Company has announced a number of changes and promotions.

Philip W. Hatch has been appointed Assistant to David R. Parfitt, Vice President in Charge of Sales. Mr. Hatch recently joined Thatcher after a 20-year association with Ball Brothers Company, for the last several years of which he was Sales Manager of the Commercial Container Division.

Also new in the sales department is Walter S. Bazzett who has been appointed Sales Manager of Thatcher's Beer and Beverage Container Division. Formerly assistant Sales Manager of the Milk Container Division, Mr. Bazzett has been with Thatcher since 1937, serving for some years with the sales division at its Long Island branch plant. Mr. Bazzett started work with Thatcher 15 years ago as a Shipping Room Dispatcher.

Since Thatcher's recent merger with McKee Glass Company, Harold E. Donaldson has been transferred from Jeannette to Elmira and appointed Manager of Specialized Product Sales. Mr. Donaldson has been with the McKee organization for 23 years supervising production, in charge of Quality Control and, most recently, in Sales and Advertising.

EXECUTIVE CHANGES AT LIBBEY-OWENS-FORD

Important changes in the executive supervision of technical and product divisions of Libbey-Owens-Ford Glass Company, forecasting closer integration of all company activities, have been announced as a result of the recent retirement of D. H. Goodwillie, former Executive Vice President.

C. P. MacNichol, Jr., Vice President, in addition to his continued direction of sales and related activities, will supervise both the Fiber Glass and Liberty Mirror Divisions. Curtis W. Davis, Vice President, continuing in charge of production and related responsibilities, will have general direction of the L-O-F glass technical departments, including engineering, research and product development.

Stuart S. Wall, Vice President and General Counsel, will take over general supervision of the Patent Department, in addition to his duties as head of the company's Legal Department.

John D. Biggers, President, will have direct supervision of Plaskon Division, working closely with W. W. Knight, Jr., General Manager of Plaskon Division, in developing "ultimate possibilities" of this unit in its molding compound, coating resin, glue and industrial resin field.

HAZEL-ATLAS APPOINTMENTS

J. H. McNash, President of Hazel-Atlas Glass Company, has announced the following promotions in officer personnel: H. G. Lewis was elected Vice President; N. C. Ross was elected Treasurer; C. E. Ewing was elected Assistant Secretary.

Mr. Lewis has been employed by the company in various capacities since 1932, as the Secretary since 1946, and as Secretary and Treasurer since 1949. In addition to his duties as Vice President, he will continue to serve as Secretary. Mr. Lewis was engaged in production, sales and financial activity prior to his association with the company.

Mr. Ross succeeds Mr. Lewis as Treasurer. He has been associated with the company since 1941 and in the capacity of Assistant Treasurer since 1949. Mr. Ross was engaged in professional accounting prior to his association with Hazel-Atlas.

Mr. Ewing joined the firm in 1931 and has served as Purchasing Agent since 1946.

It was also announced that C. R. Dilmore succeeded Mr. Ewing as Purchasing Agent. Mr. Dilmore has been employed by the company since 1933 and has been associated with the Purchasing Department since 1942.

REMMEY COMPANY ADDS TO SALES STAFF

The Richard C. Remmey Son Company has announced that Russell B. Jenner has joined the firm as Sales Service Representative for the New England area.

Mr. Jenner was formerly with the Harbison-Walker Refractories Company as Manager of the Special Refractories Division.

• Gustin-Bacon Manufacturing Company has extended the distributing territory of Western Fiberglas Supply Company of San Francisco, to include the entire Pacific Coast and Alaska. The distributor handles the company's Ultralite glass fiber insulation.

BAUSCH & LOMB SCIENTISTS ATTEND INTERNATIONAL COMMISSION ON GLASS

Two scientists from Bausch & Lomb Optical Company have left for London, England, where they will represent the United States at a meeting of the International Commission on Glass. They are Dr. Norbert J. Kreidl (*right, above*), Director of Chemical Research at Bausch & Lomb, and Vincent M. Young (*left, above*), head of the firm's glass plant. The 36-man international commission consists of three representatives chosen by ceramic societies in each of 12 glassmaking countries.

At the week-long technical sessions dealing with physical and chemical properties of glass and standards on glass quality, Dr. Kreidl will represent W. E. Cramer, President of the American Ceramic Society. While abroad, Dr. Kreidl and Mr. Young will also visit optical glass plants and laboratories in France, Germany, Austria and Italy and will return to the United States on July 5.

UNION PACIFIC RR PUBLISHES TERRITORIAL MAP OF U. S.

A new issue of Union Pacific Railroad's "Freight Rate Territorial Map of the United States" is now being distributed, according to W. T. Burns, Vice President-Traffic for the railroad.

The map shows in color the territory and jurisdiction of the various freight rate bureaus and also the transcontinental groupings published in accordance with "Articles of Organization and Procedure" filed with the ICC in compliance with Section 5A of the Interstate Commerce Act.

This 1952 publication of the map defines the new transcontinental groups as published in Trans-Continental Territorial Directory No. 5, and also includes a chart showing corresponding groups in Trans-Continental Territorial Directories Nos. 40 and 41.

Reference to a chart will show the user which rate bureaus or committees have jurisdiction over rates between points in any of the numbered areas on the map and points in any other numbered area.

Copies of the map may be secured from any Union Pacific office without charge or by writing W. T. Burns, Vice President-Traffic, Union Pacific Railroad, Omaha, Nebraska.

DR. CONDON COMMENTS . . .

(*Continued from page* 307)

several discrete exponentials, in some cases but three terms being required.

It seems to me that what is of interest here is that the structural change involved in the increase of density is resolvable into a few distinct kinds of process having characteristic rate constants. In such a complicated situation, far from expecting a simple exponential curve, one might have reasonably expected such a wide distribution of rates for different kinds of structural change that such an analysis as this into but three or four terms would not be possible.

One must not infer from the linear additivity of the exponential terms that the structural changes involved are quite independent. This is one possibility, and the simplest, but not the only one, as the following consideration shows. For brevity, consider a model giving only two exponential terms. Suppose there is a number, n_1 per unit volume, of non-equilibrium structural situations each of which alters the density by an amount d_1 and suppose the number of these tends to zero according to the zero-order reaction law so

$$\frac{dn_1}{dt} = -\lambda_1 n_1, \text{ so } n_1(t) = n_{10}\, e^{-\lambda_1 t}.$$

If there are also n_2 per unit volume of structural situations of another kind each making a density alteration of amount d_2, which are also tending to disappear independently of n_1 by the same kind of law, then

$$\frac{dn_2}{dt} = -\lambda_2 n_2, \text{ so } n_2(t) = n_{20}\, e^{-\lambda_2 t}.$$

The rate of change of density with time will be the result of the combined effect of the two different kinds of processes going on simultaneously but independently,

$$\Delta d = d_1 n_{10}\, e^{-\lambda_1 t} + d_2 n_{20}\, e^{-\lambda_2 t}.$$

But alternatively it might happen that the structural changes resulting in the increased density occur as a result of successive changes. Thus, suppose the destruction of a situation of type 1 produces a situation of type 2, which then decays to produce the final equilibrium structure. In this case

$$\frac{dn_1}{dt} = -\lambda_1 n_1, \text{ so } n_1(t) = n_{10}\, e^{-\lambda_1 t}$$

as before, but now, since decrease of n_1 feeds n_2,

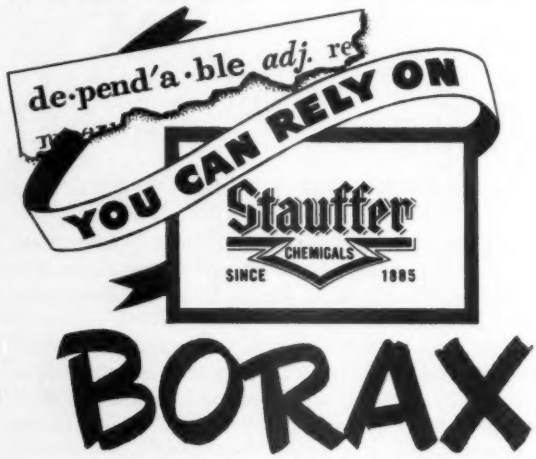
$$\frac{dn_2}{dt} = -\lambda_2 n_2 + \lambda_1 n_1$$

which gives

$$n_2(t) = \frac{\lambda_1 n_{10}}{\lambda_2 - \lambda_1}\, e^{-\lambda_1 t} + C\, e^{-\lambda_2 t}$$

and therefore the density change, which is assumed linear in n_1 and n_2, will also consist of two exponential terms as before. Thus it is not possible to distinguish these two cases merely by analysis of the time dependence of the density.

In the past, other empirical forms have been used in describing effects of this kind. Thus, V. Stott (Jl. Soc. Glass Tech. *21*, 356 (1937)) represents his data on the delayed elastic effect in torsion of a glass rod by a formula



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Granular

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of the type, due to A. A. Michelson, $\log \Theta(t) = A - B\sqrt{t}$, a form not clearly compatible with any rate theory of physico-chemical processes. An examination of his data shows that they are equally well represented by $\Theta(t) = 2.5\ e^{-t/1} + 4.7\ e^{-t/19.2}$ where t is in minutes, suggesting that it is related to two distinct mechanisms of structural change proceeding with different relaxation rates.

Sincerely,

E. U. Condon, Director of Research
Corning Glass Works
Corning, N. Y.

FOOTE MINERAL BUYS PROPERTY

Ernest G. Enck, Secretary of Foote Mineral Company, announces the purchase of surface rights to approximately 37 acres of land adjoining their Kings Mountain holdings in North Carolina. This tract is a portion of the Park Yarn Mill to which the Foote Mineral Company had acquired mineral rights in October 1951.

This latest acquisition will add to the already sizable deposits of high grade Spodumene which the Foote company is currently mining at this location. Spodumene is a basic raw material for the production of lithium chemicals.

• James F. Donnelly, an executive of the A. O. Smith Corporation, was elected President of the Gas Appliance Manufacturers Association at the Association's 17th annual meeting.

LYNCH ELECTS VICE PRESIDENT

Following the annual meeting of stockholders of Lynch Corporation, the Directors elected Russell L. Sears a Vice President of the company. Mr. Sears joined Lynch in 1944 as Sales Manager of its Compressor Division and was promoted last year to General Sales Manager of the Ohio Divisions of the corporation.

Prior to his connection with Lynch, Mr. Sears was Sales Manager of the automotive division of the Sherwin-Williams Paint Company.

Also at the annual meeting, the seven directors of the company were re-elected. The directors, in addition to Mr. Sears' re-election to a vice presidency, re-elected Uz McMurtrie, Chairman of the Board; F. K. Zimmerman, President; T. C. Werbe, Jr., Vice President; A. G. Doll, Vice President; and J. H. McGivern, Secretary-Treasurer. Appointed to act as Assistant Secretary and Assistant Treasurer were Ellen Podmore and K. C. Sturgeon, respectively.

FIRST QUARTER FINANCIAL REPORTS

Sales and earnings of Libbey-Owens-Ford Glass Company made a moderate increase in the first quarter of 1952 and were $38,375,300 and $3,453,619, respectively. During the first quarter of 1951, sales were $49,767,000 and earnings were $6,150,810.

Net sales of Diamond Alkali Company for the quarter ended March 31, 1952 were $20,501,624 as compared to $18,977,055 for the same period in 1951. First quarter income after taxes was $1,646,869 compared with $1,858,391 for 1951.

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EXACT WEIGHT Scale Model #706 for table operation. Popular today for weighing large television tubes. Also used for checkweighing heavy glass containers for close tolerance. End tower design with dial in direct line for easy vision in production line checkweighing. Dial 8 ozs. over and underweight by 1 oz. graduations. High speed due to short platter fall. Capacity to 27 lbs.

Since very small glass containers demand a high degree of accuracy we recommend the Shadograph, both hot and cold end. The model #9062 (illustrated) can be built to specifications for checking the smallest glass containers now made. These scales give you better accuracy, frictionless shado indication which substitutes light projection indication for mechanical readings. Sensitivity is keen . . . too 2 Mg. All of these models are electrically operated, either DC or AC. Capacity to specifications.

EXACT WEIGHT Scale Model #88-G. Recommended for checking at the hot end. Has convenient carrying handle. Dial markings by 1/16 oz. graduations or 1 gram metric. Weighs accurately on level or out-of-level benches. Capacity to 3 lbs. or 2000 grams metric.

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Industrial Precision

THE EXACT WEIGHT SCALE COMPANY

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G.C.M.I. MEETING

(*Continued from page* 306)

operations. Appendix A of the Glossary is a listing of the various pulps and boards used in making the fiber boxes for the glass container industry. Appendix B gives the descriptions of the many physical tests used in evaluating the boards and shipping containers, and Appendix C gives the styles of boxes frequently used in the glass container industry.

Committee Bulletin No. 7, entitled "Government Packaging Specifications", was issued by the Package Committee to explain some of the recent changes in certain Government packaging specifications. With respect to packaging research and development projects, Mr. Wells stated that in spite of the fact that in recent months the G.C.M.I. Packaging Research Laboratory has been devoting a large portion of its time to one specific survey, the research phases of the Committee's long range program have been proceeding on schedule and the most important research project, the G.C.M.I. Cushion Tester, has proven itself a very practical evaluator of partition quality. At the recent Packaging Design Committee meeting, three oral reports were presented which were based on information obtained with the Cushion Tester.

OPS APPROVES PRICE INCREASE OF GLASS CONTAINERS

Manufacturers of certain glass containers have been authorized by the Office of Price Stabilization to increase their ceiling prices established under the General Ceiling Price Regulation (GCPR) by four per cent.

The action was covered by Supplementary Regulation 99 to GCPR, effective April 23, 1952, and is taken because it is indicated that the industry is entitled to a price increase under the industry earnings standard.

The glass container industry is composed of 33 firms operating 110 plants. All but five of these firms are engaged exclusively in the manufacture of glass containers.

In the latter part of 1951, the industry requested ceiling price adjustments to reflect cost increases. Earnings data subsequently submitted show that the industry's earnings have declined substantially owing to a reduction in demand and rising costs of raw materials. Production estimates for 1952 indicate that no reversal of present earnings is likely and that some increase in ceiling prices is required to satisfy the industry earnings standard.

L-O-F PURCHASES PATENT RIGHTS OF "GARAN FINISH"

Purchase of the "Garan Finish" and acquisition of certain technical services of Dr. Robert Steinman, President of the Garan Chemical Corporation, by the Fiber Glass Division of Libbey-Owens-Ford Glass Company, was announced by G. P. MacNichol, Jr., Vice President. The purchase included all patent properties and the goodwill associated with the trademarks "Garan" and "Garan Finish."

The Garan finish is a surface treatment applied to glass fibers to give them superior characteristics for reinforcing plastics, and is of outstanding importance to the aircraft industry. It is also important in other fields where glass fibers are utilized in reinforcing plastics.

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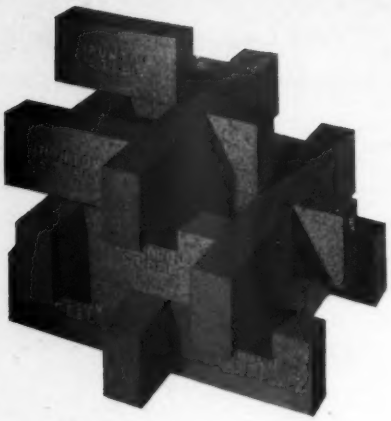

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BOOK REVIEWS

Prism and Lens Making, Second Edition
By F. Twyman, F.R.S.

This second edition has been enlarged not only by accounts of important recent developments in optical workshop practice, but also by a considerable widening of its scope.

Notable in this respect is the inclusion of chapters or sections on spectacle lenses, on the comparatively new subject of artificial crystals, and on the new standard processes of "blooming" and other surface treatments. New also are the chapters on non-spherical surfaces and on large mirrors and lenses, the one reflecting the strides made in the application of the Schmidt camera and its derivatives, the other having special reference to great astronomical telescopes.

Chapter headings include Single Surface Working, Prisms, Lenses; The Nature of Grinding and Polishing; Tools and Materials in General Use; Dioptric Substances; Production of Lenses in Quantity; Microscope Lenses; Production of Prisms in Quantity; Testing Optical Work; Surface Treatments, etc.

Published by Hilger & Watts Ltd., London, England; Available in the United States from The Jarrell-Ash Company, 165 Newbury Street, Boston, Mass.; 640 pages; Bound in cloth boards; $11.25.

North American Combustion Handbook

The purpose of this handbook is to provide users of combustion equipment with a basic explanation of the theory of combustion, to outline combustion, heat transfer and fluid flow calculations, to present charts and data to simplify and speed these calculations and to present a discussion of combustion equipment, its selection and operation.

The first chapter of the book is intentionally elementary as it is designed specifically for the newcomer to the field of combustion engineering. Although the stated scope of the handbook is industrial heating with gaseous and liquid fuels, the reader will find that the book also contains considerable information applicable to commercial heating and to solid fuels.

Chapter headings include The Elements of Combustion, Fuels, Combustion Analysis, Heat Transfer, Flow of Fluids, Burner Equipment, Combustion Control and Combustion Systems.

Produced by The North American Manufacturing Co., Cleveland 5, Ohio; 322 pages; $2.00.

The Clays and Shales of New York State
In cooperation with New York State College of Ceramics and New York State Science Service

Designed specifically to assist manufacturers of pottery, tiles, brick and other ceramic products, this 349-page book is the first comprehensive, scientific survey of New York State's deposits of clays and shales.

By means of text and 68 charts and diagrams, the book lists and describes samples of clays and shales in every region of the State, locating each deposit site so that any interested person can find it. Such details as the chemical and mineralogical analyses, unfired properties and fired strength are listed for each sample on the basis of laboratory tests.

Available without charge to responsible persons in the ceramics and related industries, requests should be made to the New York State Department of Commerce, 112 State Street, Albany 7, New York.

Coloured Glasses
By Professor W. A. Weyl

This monograph is a collected presentation of the original paper which appeared in six sections in the *Journal of the Society of Glass Technology* over a period of time from 1943 through 1946. As each installment was published in the *Journal*, THE GLASS INDUSTRY published extended summaries. These appeared throughout the period of 1944 through 1947. For issue in book form, the original version has been thoroughly revised. A number of sections have been rewritten so as to provide explanations of phenomena based on the latest views of the constitution of glass. There are also some entirely new sections so that, in all, the text now occupies some fifty more pages than did the original version.

In this monograph, there are five sub-divisions: The Constitution of Coloured Glasses; The Colours of Glasses Produced by Various Colouring Ions; The Colours of Glasses Produced by the Non-Metallic Elements: Sulphur, Selenium, Tellurium, Phosphorous and Certain of Their Compound; The Colours Produced by Metal Atoms; and The Fluorescence, Thermoluminescence and the Solarisation of Glass.

Available through The Society of Glass Technology, "Elmfield," Northumberland Road, Sheffield 10, England; 541 pages; Bound in cloth; Price £1 15s. Od. plus 8d. postage.

Directory for The British Glass Industry, Fifth Edition
Compiled by D. W. Rollin and E. Rollin

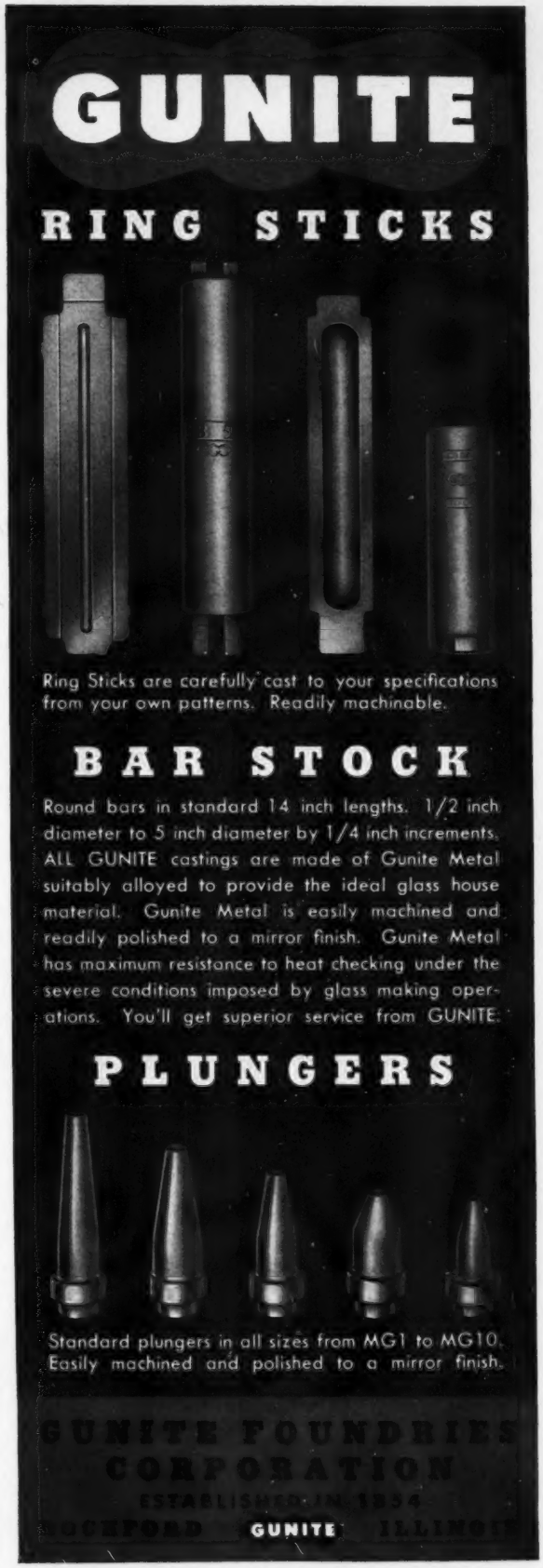
This Directory of the British glass industry includes an alphabetical list of those glass manufacturers who are engaged in the manufacture of glass articles from molten glass; an alphabetical list of glass manipulators and users, including manufacturers of lampworked and scientific glass articles, optical apparatus, and constructional glass products; an alphabetical list of suppliers of plant machinery and materials; alphabetical lists of industrial associations, trade unions, research organizations, institutes and societies, livery companies of the City of London, and educational institutions and schools; alphabetical list of proprietary and trade names; and alphabetical list of products and services and names of suppliers.

Published by The Society of Glass Technology, "Elmfield," Northumberland Road, Sheffield 10, England, 451 pages.

BABCOCK & WILCOX MOVES HEADQUARTERS

The Babcock & Wilcox Company has opened offices at its new headquarters in the recently completed 32-story, fully air-conditioned Chrysler Building East at 161 East 42nd Street, following one of the largest moves from the financial district in many years. The company has had its general office in the downtown district of New York for more than three quarters of a century.

In its new headquarters, the firm will occupy the second through the sixth floors and will be the largest single tenant in Chrysler Building East.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The Glass Industry

55 WEST 42nd STREET

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At a preview of the exposition, "Industrial Progress, U.S.A.," held in the Ford Museum, Dearborn, Mich., Benson Ford, President of Lincoln-Mercury, Hugh Laughlin, Vice President of Owens-Illinois Glass Co., and William Ford, President of the Museum, look over a display of old and new glass containers sponsored by the glass company.

GLASSWARE SHOW PART OF INDUSTRIAL EXHIBITION SPONSORED BY O-I AND HENRY FORD MUSEUM

One hundred and sixty years of fine American glass making is depicted in a display that will be shown on a nationwide tour sponsored by the Owens-Illinois Glass Company in cooperation with the Henry Ford Museum.

The glassware show is a feature of the exhibition "Industrial Progress, U.S.A." which will travel for three years and visit every American city of more than 100,000 population. More than 3,000,000 are expected to see it. The show was opened to the public for the first time on May 4 at the Museum in Dearborn, Mich. The nationwide tour opened in Cleveland May 12 to the 17th.

The exhibition includes displays from 20 companies, each portraying progress in a different industry. The Owens-Illinois exhibit represents progress in glass containers. Among the 32 glass containers displayed there are several dating back to 1790. There is a Colonial ink bottle, an opaque toilet water bottle from Civil War days, a pair of rare wine glasses and old time containers for medicines, sauces and liquors, all made of hand-blown glass. In contrast to these there are a number of modern glass containers, produced on automatic machines at the rate of 300 a minute, which demonstrate the development of lightweight, stronger glass containers for mass distribution.

The display also shows a set of glass blower's tools used in the blowing and forming of hand-blown glass. Other displays in the exhibition portray progress in illumination, in feminine apparel, in photography, transportation, laundering and sewing.

After Cleveland the exhibition will be shown for six days in each of the following cities: Akron, Canton, Pittsburgh, Youngstown and Wheeling, W. Va., to complete the first leg of its tour.

• Forter-Teichmann, Inc., has announced removal of its offices to the Clark Building, Pittsburgh 22, Pa.

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A. C. S. MEETING . . .
(*Continued from page* 302)

mining Pressure-Strain Relationships on Television Envelopes," A. Cohen and R. F. Doran, Sylvania Electric Products, Inc., was presented by A. Cohen. Highly practical, this paper presented information of considerable value to television tube manufacturers. There has been considerable cracking of television envelopes in the shoulder area during the cooling cycle. In order to ascertain the distribution of strain over the face of the envelope, wire gauges were mounted on the face at desired points, while the tubes were broken by external pressure in a pressure chamber. The gauge operated on the principle that the wire resistance varies with expansion or contraction of the wire owing to the strain induced in the glass. Experimental data indicated that all envelopes showed compression in the center of the face and tension on the shoulder areas. Data were also given showing the effects of design changes on zonal deformation behavior. The correlation obtained between manufacturing behavior and experimental data indicated a high tensile strain at previously known vulnerable areas as determined by implosion testing. Comparisons were made between deformations of glass envelopes and metal-glass combinations. This method of testing appears to offer a valuable means of determining strain distribution and zonal weaknesses which should lead to better design and manufacturing control.

At the annual Business Meeting of the Section, the Fall Glass Meeting was announced for October 10 and 11, 1952, at Bedford Springs Hotel, Bedford, Pa.

The elected officers of the Division are as follows: *Trustee:* K. C. Lyon, Armstrong Cork Co.; *Chairman:* F. V. Tooley, University of Illinois; *Vice-Chairman:* N. J. Kreidl, Bausch & Lomb Optical Co.; *Secretary:* F. L. Bishop, American Window Glass Co.

Professor Scholes announced that the standard glasses —including soda-lime, borosilicate and potash-lead glasses —are now available and can be obtained by writing to him at the New York State College of Ceramics, Alfred, N. Y.

It is expected that N. J. Kreidl, Bausch & Lomb Optical Co., and D. E. Sharp, Libbey-Owens-Ford Glass Co., will attend the meeting of the International Commission in London the last week in June.

The Program Committee for the coming year is composed of W. H. Manring, Calumite Co.; T. G. Pett, Bausch & Lomb Optical Co.; and F. W. Mowrey, American Window Glass Co.

At the 13th Annual Ceramic Camera Club Salon of the A.C.S., 60 prints and about 50 color transparencies were entered in the competition. Prizes in the print category were awarded as follows: *A.C.S. Awards*—Eugene D. Lynch, John Kalinich and J. Earl Frazier. *Frazier Award* (Pictorial)—George C. Haggenbottom. *Pictorial Award* —George C. Haggenbottom and Ted G. White. *Vontury Award*—Franz G. Schwable and Victor H. Remington. *Mexican Award* (Ceramic Interest)—John Kalinich and M. A. Swartz.

In the color transparencies category, the winners were: *Walter J. Gitter Memorial Award* (Ceramic Interest)— Hugh Kline. *Industrial Ceramic Award* (Ceramic Interest — Hugh Kline. *Whittaker Award* (Pictorial) — F. George Pasotti.

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New officers elected of the Ceramic Camera Club for the term 1952-53 are: J. Earl Frazier, Chairman; Theodore G. White, Secretary; Albert E. Willms, Asst. Secretary; Victor H. Remington, Immediate Past Chairman.

RADIANT HEAT . . .

(*Continued from page* 303)

ant heat, we continued to use the circulating fans in the space surrounding the furnace. Added to that were several sources of forced air supply through the floor in the workspace. In addition fans were placed in the walls of the building to produce a positive pressure within the building walls. Radiant shielding was installed by dropping corrugated aluminum sheeting from the roof level to within three feet of the floor and an extended hood type structure completely surrounding the furnace or hot object. To assure ourselves that positive flow would take place behind this shield, in some cases we have installed power type roof ventilators commonly used in the foundry trade.

The curtain or shield surrounding the furnace served two distinct purposes. They keep the radiant energy entirely confined to a central area. The infrared cannot escape to be absorbed by the steel of the structural parts of the building which in turn might become a secondary radiant. Generated gases stay within the structure and do not escape into the work space. We are sure that the temperature on the outside of these shields will remain within a few degrees of that of the outdoor temperature. Circulating fans remain to assure ourselves that the air will remain uniform in temperature throughout the work areas.

While this installation may not be a profound one engineeringwise, the following will illustrate an actual installation using this principle in which very effective results were obtained over one very hot summer. A light steel framework was erected entirely around the hot furnace. Corrugated aluminum was attached directly to this light structure by means of a blank cartridge actuated nailing device. In this way we were able to erect the entire shield in a comparatively short time.

We erected the shields to the roof level, allowing only very small openings for piping, electrical services and the necessary structural steel work. For an idea of the entire structure surrounding one large heated area, within the enclosure is a continuous type lehr. Openings at both ends were necessary to allow the continuous flow of materials. These openings were covered by a tilted hood type structure. Access openings along the sides of this annealing lehr were provided with overhead garage doors constructed of corrugated aluminum. Every other bay in the roof of the building was open to the sky either through gravity type ventilators or the power type.

• A three-day meeting on vacuum technology and its importance in the chemical manufacturing industries was the feature of the spring meeting of the American Institute of Chemical Engineers recently held at French Lick, Indiana.

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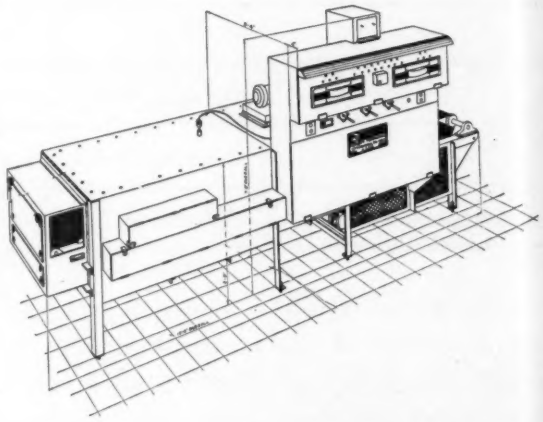
OVERMYER MOULD ANNUAL REPORT; OFFICERS AND BOARD MEMBERS ELECTED

At meetings of the stockholders of Overmyer Mould Company of Pennsylvania and Overmyer Mould Company, Inc., and the Overmyer Mould Company of Cal., Inc., President C. P. Overmyer, Sr., of these organizations, reported to the stockholders that the gross sales of all divisions for the year of 1951 were $4,000,000, and that the companies with their present facilities were in a position to produce $5,000,000 in 1952. The export sales had also increased.

There were some changes made in the Board of Directors and Officers of the three companies, and the new Officers and Board of Directors are as follows: *Greenburg, Pennsylvania:* C. P. Overmyer, Sr., President & General Manager; James Kindelan, Vice President & Factories Manager; Earl Flatter and C. M. Hawkins, Directors; Lowell Roesner, Secretary-Treasurer; and Robert Wallace, Ass't. Secretary-Treasurer. *South Gate, California Plant:* C. P. Overmyer, Sr., President & General Manager; Day Stalker, Vice President & Plant Manager; Earl Flatter and Charles Manrose, Directors; Lowell Roesner, Secretary-Treasurer; and Robert Wallace, Ass't. Secretary-Treasurer. *Winchester, Indiana Plant:* C. P. Overmyer, Sr., President & General Manager; Earl Flatter, 1st Vice President, Factories Mgr, & Labor Relations; Vernon Ruble, 2nd Vice President & Mould Factory Manager; Wilbur Snyder, 3rd Vice President & Manager of Foundry Division; Lowell Roesner, Secretary-Treasurer; and Robert Wallace, Ass't. Secretary-Treasurer.



● Above illustration shows a special electric oven for the annealing of light ware as required for the electronic field.

Our knowledge of glass factory problems is your assurance of first quality glass melting and manufacturing equipment, as well as top service and performance.

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RESEARCH DIGEST . . .

(*Continued from page* 313)

repose, but down a "plane of rupture" located well above the angle of repose.

The principles behind successful design are: (1) have gate large enough. Size of outlet should be such that proper flow develops with the gate about half-way open. Then the gate can be opened further to clear a partial choke. Size should be selected by previous experience when such is available. Size should also be large enough to pass ordinary lumps when half open. On the other hand, if the gate is made larger than necessary, you may find it too difficult for one man to operate

(2) Have *least* slope steep enough to be self-cleaning. The valley angles are the ones to watch: they should be a little steeper than the angle of repose. Steeper slopes do not help. Handbooks give the angle of repose for some materials, or the angle can be easily determined by experiment. (3) If one straight side is insisted upon, do not flatten out the opposite side so that material will not run down the valley.

Make it a principle to empty out material all the way, fairly frequently. This is especially true of material which can cake up in storage and of material which may vary somewhat in analysis or physical appearance from time to time as it is put in storage.

• Chain Belt Company is now occupying its new administration building located at 4701 W. Greenfield Avenue, Milwaukee, Wisconsin.

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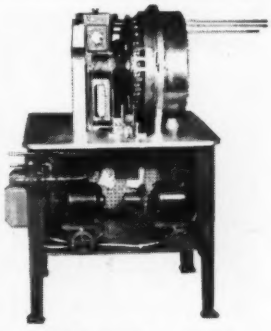

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